Contractors' & Engineers' Purchasing Guide

Monthly news and classified lists of machinery and supplies for engineers, contractors, and other purchasers of construction equipment.

AUGUST-SEPTEMBER 1920

AUG - SEP 1920

Where to Purchase

A comprehensive Directory of the leading machinery and supply manufacturers arranged for the convenience of engineers and contractors who may desire to secure catalogs or prices on construction equipment. Where the name of a manufacturer is preceded by a star (*) it indicates that the user of the directory may secure further information regarding the products of this manufacturer by referring to his advertisement in this issue of the Guide. The index to advertisers will be found on page facing the inside back cover.

ACETYLENE
Linde Air Products Co., New York.
Prest-O-Lite Co., Inc., New York.

ACETYLENE APPARATUS
Oxweld Acetylene Co., Newark, N. J.

ADDING MACHINES
*Marchant Calc. Machine Co., Oakland, Cal.
*Monroe Calculating Machine Co., Orange, N. J.

AIR AND GAS WASHERS
*Spray Engineering Co., Boston, Mass.

AIR COMPRESSORS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., Trenton, N. J.
*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Indiana Air Pump Co., Indianapolis, Ind.
*Nordberg Mfg. Co., Milwaukee, Wis.
*United Iron Works Co., Kansas City, Mo.
*Worthington Pump & Mchy. Corp., N. Y. C.
Cement-Gun Co., Inc., Allentown, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
De La Vergne Machine Co., N. Y. C.
Gardner Governor Co., Quincy, Ill.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., N. Y. C.
Norwalk Iron Works Co., South Norwalk, Conn.
Schramm & Son, Inc., Chris. D., Philadelphia, Pa.
Standard Scale & Supply Co., Pittsburgh, Pa.
Stratton & Bragg Co., Petersburg, Va.
Sullivan Mchy. Co., Chicago, Ill.
Westinghouse Trac. Brake Co., Wilmerding, Pa.

ARC LAMPS
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ARCHITECTURAL IRON WORK
*Stewart Iron Works, Cincinnati, O.
Chesapeake Iron Works, Baltimore, Md.
Dietrich Bros., Baltimore, Md.
Hirsch Rolling Mill Co., St. Louis, Mo.
Snead Arch Iron Works, Louisville, Ky.

ARMORED CONCRETE PAVEMENTS
*Truscon Steel Co., Youngstown, Ohio.

ARTESIAN WELL DRILLS AND PUMPS
Am. Well Works, Aurora, Ill.

ASBESTOS, ETC.
*Carey Co., Philip, Cincinnati, Ohio.
Dominion Asbestos & Rubber Corp., N. Y. C.
Keasbey & Mattison Co., Ambler, Pa.

ASH HANDLING MACHINERY
*Haiss Mfg. Co., Geo., New York.
*Otterson Auto Eductor Co., Springfield, O.
Bartlett & Snow Co., C. O., Cleveland, O.
Brown Hoisting Mach. Co., Cleveland, Ohio.
Byers Mach. Co., J. F., Ravenna, Ohio.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Green Eng. Co., East Chicago, Ind.
Guarantee Constr. Co., N. Y. C.
Jeffrey Mfg. Co., Columbus, Ohio.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Portable Mchy. Co., Passaic, N. J.
Robins Conv. Belt Co., N. Y. C.
Webster Mfg. Co., Tiffin, O.

ASPHALT
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Barrett Co., New York.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Standard Oil Co. of Ind., Chicago, Ill.
*Texas Co., N. Y. C.
*Warren Bros. Co., Boston, Mass.
Atlantic Refining Co., Philadelphia, Pa.
Gulf Refining Co., Pittsburgh, Pa.
Headley Good Roads Co., Philadelphia, Pa.
Standard Oil Co. of N. Y., N. Y. C.
Standard Oil Co. of N. J., Newark, N. J.
U. S. Asphalt Refining Co., N. Y. C.

ASPHALT MACHINERY
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Dyar Supply Co., Cambridge, Mass.
*Kinney Mfg. Co., Boston, Mass.
*Littleford Bros., Cincinnati, O.
*Warren Bros. Co., Boston, Mass.
Hetherington & Berner, Indianapolis, Ind.

ASPHALT PLANTS
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Warren Bros. Co., Boston, Mass.
Austin Machinery Corp'n., Chicago, Ill.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, Ohio.
Hetherington & Berner, Indianapolis, Ind.

ASPHALT SURFACE HEATERS
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Equitable Asphalt Maint. Co., Kansas City, Mo.

ASPHALT TOOL FURNACES
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Littleford Bros., Cincinnati, Ohio.
Hetherington & Berner, Indianapolis, Ind.

BACKFILLERS
*Koehring Machine Co., Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
Austin Machinery Corp'n., Chicago, Ill.
American Cement Mchy. Co., Inc., Keokuk, Ia.
Byers Mach. Co., J. F., Ravenna, Ohio.
Oshkosh Mfg. Co., Oshkosh, Wis.
Parsons Co., Newton, Ia.
Waterloo Constr. Mchy. Co., Waterloo, Ia.

BAR BENDERS AND CUTTERS
*Koehring Machine Co., Milwaukee, Wis.
Electric Welding Co., Pittsburgh, Pa.
Hinman & Co., D. A., Sandwich, Ill.
Ransome Concrete Machinery Co., Dunellen, N. J.

BAR CHAIRS, REINFORCING
*Truscon Steel Co., Youngstown, Ohio.
Concrete Steel Co., N. Y. C.
Universal Clamp Co., Chicago, Ill.

BARS, IRON AND STEEL
Aborn Steel Co., Inc., N. Y. C.
Bethlehem Steel Co., So. Bethlehem, Pa.
Carbon Steel Co., Pittsburgh, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Franklin Steel Works, Franklin, Pa.
Gulf States Steel Co., Birmingham, Ala.
Hirsch Rolling Mill Co., St. Louis, Mo.
Illinois Steel Co., Chicago, Ill.
Inland Steel Co., Chicago, Ill.
Lackawanna Steel Co., Buffalo, N. Y.
Midvale Steel & Ordnance Co., Philadelphia, Pa.
Republic Iron & Steel Co., Youngstown, O.
St. Louis Screw Co., St. Louis, Mo.

Where to Purchase

BELTING, RUBBER
*Goodyear Tire & Rubber Co., Akron, O.
Allen Mfg. Co., W. D., Chicago, Ill.
Carpenter & Co., Geo. B., Chicago, Ill.
Fairbanks Co., The, N. Y. C.
Goodall Rubber Co., Inc., Philadelphia, Pa.
Hopkins-Benedict Co., Chicago, Ill.
Kelley-Derby Co., Inc., Chicago, Ill.
McMaster-Carr Supply Co., Chicago, Ill.
Mulconroy Co., Inc., Philadelphia, Pa.
Pa. Rubber Co., Jeannette, Pa.
Salisbury & Co., Inc., W. H., Chicago, Ill.
Southern Supply & Equip. Co., St. Louis, Mo.
Southern Rubber & Belt. Co., Houston, Tex.
Union Asbestos & Rubber Co., Chicago, Ill.
Voorhees Rubber Mfg. Co., Jersey City, N. J.
Wood, Guilford S., Chicago, Ill.

BENDING MACHINES (PIPE)
*Amer. Pipe Bending Mach. Co., Boston, Mass.
Hinman Co., D. A., Sandwich, Ill.
Walworth Mfg. Co., Boston, Mass.

BINS, STORAGE
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
*Ransome Concrete Machy. Co., Dunellen, N. J.
Berger Mfg. Co., Canton, Ohio.
Galion Iron Works & Mfg. Co., Galion, Ohio.
Green Engineering Co., E. Chicago, Ind.
Petroleum Iron Works Co., Sharon, Pa.

BLASTING POWDER (See Explosives)

BLOCKS AND TACKLE
Boston & Lockport Block Co., East Boston, Mass.
Broderick & Bascom Rope Co., St. Louis, Mo.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Topping Bros., N. Y. C.
Upson-Walton Co., Cleveland, Ohio.

BLOWERS, PRESSURE
*De Laval Steam Turbine Co., Trenton, N. J.
American Blower Co., Detroit, Mich.
American Gas Furnace Co., N. Y. C.

BLUE PRINT MACHINES
Indianapolis Blue Print & S'ply Co., Ind'apolis.

BLUE PRINT PAPERS
*Kolesch & Co., New York.
Indianapolis Blue Print & S'ply Co., Ind'apolis.

BOILERS
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Ames Iron Works, Oswego, N. Y.
Babcock & Wilcox Co., N. Y. C.
Cameron & Barkley Co., Charleston, S. C.
Casey-Hedges Co., Chattanooga, Tenn.
Chandler & Taylor Co., Indianapolis, Ind.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Cole Mfg. Co., R. D., Newnan, Ga.
Erie City Iron Works, Erie, Pa.
Flory Mfg. Co., S., Bangor, Pa.
Hartley Boiler Works, Montgomery, Ala.
Heine Safety Boiler Co., St. Louis, Mo.
Houston, Stanwood & Gamble Co., Cincinnati, O
Industrial Works, Bay City, Mich.
Leffel & Co., J., Springfield, O.
Lombard Iron Works, Augusta, Ga.
Lord & Burnham Co., Irvington, N. Y.
Mecklenburg Iron Works, Charlotte, N. C.
Murray Iron Works Co., Burlington, Ia.
New Bern Iron Wks. & Sup. Co., New Bern, N. C.
Petroleum Iron Works Co., Sharon, Pa.
Randle Mchy. Co., Cincinnati, O.
Schofield Iron Works, Macon, Ga.
Traylor Engr. & Mfg. Co., Allentown, Pa.
Valk & Murdoch Co., Charleston, S. C.
Vogt Mchy. Co., Inc., Louisville, Ky.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

BOLTS, NUTS, NAILS, RIVETS, SPIKES
American Screw Co., Providence, R. I.
American Spike Co., N. Y. C.
Ames, W. & Co., Jersey City, N. J.
Beck & Corbitt Iron Co., St. Louis, Mo.
Bethlehem Steel Co., Bethlehem, Pa.
Camden Forge Co., Camden, N. J.
Clark Bros. Bolt Co., Milldale, Conn.
Grant, Robt., N. Y. C.
Hoffman & Co., R. C., Inc., Baltimore, Md.
Inland Steel Co., Chicago, Ill.
Larkin, J. K., N. Y. C.
Milton Mfg. Co., Milton, Pa.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Progressive Mfg. Co., Torrington, Conn.
Republic Iron & Steel Co., Youngstown, O.
Rhode Island Tool Co., Providence, R. I.
Russell, Bursdall & Ward Co., Port Chester, N. Y.
Ryerson & Son, J. T., Chicago, Ill.
St. Louis Screw Co., St. Louis, Mo.
Star Exp. Bolt Co., N. Y. C.
Topping Bros., N. Y. C.

BRACES, TRENCH
*Clow & Sons, J. B., Chicago, Ill.
*Waldo Bros. & Bond Co., Boston, Mass.
Duff Mfg. Co., Pittsburgh, Pa.

BRASS GOODS
*Mueller Mfg. Co., H., Decatur, Ill.
*Union Water Meter Co., Worcester, Mass.
Central Brass Co., Cleveland, O.
Glauber Brass Mfg. Co., Cleveland, O.
Hays Mfg. Co., Erie, Pa.
United Brass Mfg. Co., Cleveland, O.

BRICK, PAVING (See Paving Brick)

BRIDGES AND BUILDINGS, STEEL
*Chicago Bridge & Iron Works, Chicago, Ill.
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
American Bridge Co., N. Y. C.
Bellefontaine Bridge & Steel Co., Pittsburgh, Pa.
Belmont Iron Works, Philadelphia, Pa.
Berlin Constr. Co., Berlin, Conn.
Bethlehem Steel Bridge Corp., Bethlehem, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Boston Bridge Works, Boston, Mass.
Central States Bridge Co., Indianapolis, Ind.
Champion Bridge Co., Wilmington, O.
Chesapeake Iron Works, Baltimore, Md.
Eastern Bridge & Struc. Co., Worcester, Mass.
Ferguson Co., H. K., Cleveland, O.
Flour City Orn. Iron Co., Minneapolis, Minn.
Fort Pitt Bridge Works, Pittsburgh, Pa.
Hydraulic Steelcraft Co., Cleveland, O.
Ingalls Iron Works, Birmingham, Ala.
Inland Steel Co., Chicago, Ill.
Inter. Steel & Iron Co., Evansville, Ind.
King Bridge Co., Cleveland, O.
Lackawanna Bridge Co., Buffalo, N. Y.
Louisville Bridge & Iron Co., Louisville, Ky.
McClintic Marshall Co., Pittsburgh, Pa.
Milwaukee Bridge Co., Milwaukee, Wis.
Minn. Steel & Mchy. Co., Minneapolis, Minn.
Missouri Vy. Bdge. & Iron Co., Leavenworth, Kan.
Morava Constr. Co., Chicago, Ill.
Mt. Vernon Bridge Co., Mt. Vernon, Ohio.
Penn. Bridge Co., Beaver Falls, Pa.
Richmond Struc. Steel Co., Richmond, Va.
Riverside Bridge Co., Martins Ferry, O.
Toledo Bridge & Crane Co., Toledo, O.
Virginia Bridge & Iron Co., Roanoke, Va.
Wisc. Bridge & Iron Co., North Milwaukee, Wis.

BUCKETS, AUTOMATIC DUMPING
*Littleford Bros., Cincinnati, O.
Lakewood Engineering Co., Cleveland, O.

BUCKETS, CLAM SHELL
*Haiss Mfg. Co., Geo., N. Y. C.
Advance Eng. Co., Cleveland, O.
Austin Mach. Corp., Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.
Brosius, E. E., Pittsburgh, Pa.
Brown Hoisting Mchy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Byers Mach. Co., J. F., Ravenna, O.
Hayward Co., N. Y. C.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
Lakewood Engineering Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Orton & Steinbrenner, Chicago, Ill.
Owen Bucket Co., Cleveland, O.
Vulcan Iron Works, Jersey City, N. J.
Williams Co., G. H., Erie, Pa.

BUCKETS, CONCRETE
*Rochester Can Co., Rochester, N. Y.
*Ransome Concrete Machy. Co., Dunellen, N. J.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Smith Co., T. L., Chicago, Ill.
Union Iron Works, Inc., Hoboken, N. J.

A "Daring Experiment"

in "Mexico's Treasure-House"

GUANAJUATO REDUCTION AND MINES COMPANY

Sand leaching tanks, with slime tanks in background, showing sands under treatment

"The position of the Bustos mill site, in a narrow valley with little flow of water to carry off the residues, made necessary a somewhat daring experiment, that of separating the crushing and concentrating portion of the plant by a distance of nearly a mile from the cyanide plant, which could be located on the main stream of the district where there is always sufficient water to carry away residue or tailings discharged. Against practically the unanimous opinion of all visiting engineers who were consulted, it was decided to carry the ores, after they had been crushed and concentrated, through a small cast-iron pipe, laid with uniform grade, from the Bustos mill to the cyanide plant situated in the heart of the city, utilizing simply the flow of the water in which the ore was crushed, due to the gravitation of the pipe. As the grade available was only 2¼% it was believed by almost every one that the sand could not be carried, and that the pipe would inevitably be choked and stopped up.

* * * * * *

"The plants were started March 1, 1906, and have been in constant operation, 24 hours a day, since that time. The pipe line, which was looked upon with so much fear by visitors, demonstrated at once that not only was there no danger of stoppage but that it would actually carry several times the volume of treated pulp with perfect ease, and with much less water than is normally used in the mere crushing and concentrating of ores. In fact, before the normal stamp-mill pulp, coming from the concentrators, is introduced into such pipe line, the company, by means of large settling cones, are removing something like 50% of the water and returning it immediately for mill use, the pulp flowing through a mile of 8-inch cast-iron pipe without experiencing the slightest difficulty, thus effecting the transportation of 250 tons of ore per day, for the distance of a mile through the heart of a crowded city, and this without a cent of expense. The pipe being, in general, buried throughout a considerable distance of its length, requires no expensive maintenance or inspection, and the right of way for such a line was, naturally, but a small fraction of what would have been necessary for any other means of transportation possible." (From "Mexico's Treasure-House," by Percy F. Martin, F. R. G. S., pages 93-94.)

The Cast Iron Pipe Publicity Bureau

1 BROADWAY NEW YORK CITY

Where to Purchase

BUCKETS, DRAGLINE
Austin Mach. Corp., Chicago, Ill.
Brown Hoisting Mach. Co., Cleveland, O.
Bucyrus Co., So. Milwaukee, Wis.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., N. Y. C.
Industrial Works, Bay City, Mich.
Monighan Machine Co., Chicago, Ill.
Sauerman Bros., Chicago, Ill.

BUCKETS, DREDGING AND EXCAVATING
Austin Mach. Corp., Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.
Bucyrus Co., S. Milwaukee, Wis.
Fairbanks Steam Shovel Co., Marion, O.
Hayward Co., N. Y. C.
Insley Mfg. Co., Indianapolis, Ind.
Kiesler Co., J. F., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Monighan Machine Co., Chicago, Ill.
Owen Bucket Co., Cleveland, O.
Union Iron Works, Inc., Hoboken, N. J.

BUCKETS, ORANGE PEEL
*Haiss Mfg. Co., Geo., N. Y. C.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
McMyler Interstate Co., Cleveland, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Orton & Steinbrenner Co., Chicago, Ill.
Vulcan Iron Works, Jersey City, N. J.

BUILDINGS, STEEL (See Bridges and Buildings)

BUNKS AND COTS
Fort Pitt Bedding Co., Pittsburgh, Pa.
Haggard & Marcusson Co., Chicago, Ill.
Southern Rome Co., Baltimore, Md.

CABLES (See Wire and Cables)

CABLEWAYS
Allen Eng. Co., Philadelphia, Pa.
Broderick & Bascom Rope Co., St. Louis, Mo.
Flory Mfg. Co., S., Bangor, Pa.
Lidgerwood Manufacturing Co., New York.
Roebling Sons Co., J. A., Trenton, N. J.
Sauerman Bros., Chicago, Ill.
Waterbury Co., N. Y. C.
Wickwire-Spencer Steel Corpn., Worcester, Mass.

CAISSONS
American Bridge Co., N. Y. C.
Foundation Co., N. Y. C.
Lackawanna Steel Co., Buffalo, N. Y.
O'Rourke Eng. Constr. Co., N. Y. C.
Petroleum Iron Works Co., Sharon, Pa.

CALCULATING MACHINES
*Marchant Calc. Machine Co., Oakland, Cal.
*Monroe Calculating Machine Co., Orange, N. J.

CANS FOR ASHES AND GARBAGE
*American Can Co, N. Y. C.
*Rochester Can Co., Rochester, N. Y.
*Safety San. Rub. Box Co., Columbus, O.
*Steel Basket Co., Cedar Rapids, Ia.

CARS, CONCRETE
*Littleford Bros., Cincinnati, O.
*Ransome Concrete Machy. Co., Dunellen, N. J.
Austin Mach. Corp., Chicago, Ill.
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constn. Co., New York.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Koppel Ind. Car & Equip. Co., Koppel, Pa.
Lakewood Engineering Co., Cleveland, O.
Light Railway & Equipment Co., Philadelphia, Pa.
Oliver Mfg. Co., W. J., Knoxville, Tenn.
Smith Co., T. L., Chicago, Ill.

CARS, INDUSTRIAL V. DUMPING
*United Iron Works, Kansas City, Mo.
Atlas Car & Mfg. Co., Cleveland, O.
Austin Mach. Corp., Chicago, Ill.
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constr. Co., N. Y. C.
Elec. Wheel Co., Quincy, Ill.
Georgia Car & Loco. Co., Atlanta, Ga.
Insley Mfg. Co., Indianapolis, Ind.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Koppel Ind. Car & Equip. Co., Koppel, Pa.
Lakewood Engineering Co., Cleveland, O.
Light Railway Equip. Co., Philadelphia, Pa.
Oliver Mfg. Co., W. J., Knoxville, Tenn.
Ramapo Iron Works, Hillburn, N. Y.
Smith Co., T. L., Chicago, Ill.
Southern Iron & Equip. Co., Atlanta, Ga.
Whiting Fdry. Equip. Co., Harvey, Ill.

CARTS, CONCRETE
*Ransome Concrete Machy. Co., Dunellen, N. J.
Etnyre & Co., E. D., Oregon, Ill.
Gray Iron Fdry. Co., Reading, Pa.
Insley Mfg. Co., Indianapolis, Ind.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O.
Smith Co., T. L., Chicago, Ill.
Standard Scale & Supply Co., Pittsburgh, Pa.
Toledo Wheelbarrow Co., Toledo, Ohio.

CAST IRON PIPE
*American Cast Iron Pipe Co., Birmingham, Ala
*Central Fdry. Co., N. Y. C.
*Clow & Sons, J. B., Chicago, Ill.
*Lynchburg Fdry. Co., Lynchburg, Va.
*U. S. Cast Iron Pipe & Fdry Co., Burlington, N. J.
*Warren Fdry. & Mach. Co., N. Y. C.
*Wood & Co., R. D, Philadelphia, Pa.
Camden Iron Works, Camden, N. J.
Glamorgan Pipe & Foundry Co., Lynchburg, Va.

CASTINGS, IRON AND STEEL
*American Cast Iron Pipe Co., Birmingham, Ala.
*Central Fdry. Co., N. Y. C.
*Clark Co., H. W. Mattoon, Ill.
*Flower Valve Mfg. Co., Detroit, Mich.
*Lynchburg Fdry. Co., Lynchburg, Va.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
*Warren Fdry. & Mach. Co., N. Y. C.
Camden Iron Works, Camden, N. J.
Glamorgan Pipe & Foundry Co., Lynchburg, Va.
Gray Iron Fdry. Co., Reading, Pa.
Jeffrey Mfg. Co., Columbus, O.
Marion Malleable Iron Works, Marion, Ind.
Sessions Fdry. Co., Bristol, Conn.
Speidel, J. G., Reading, Pa.

CASTINGS, STREET AND SEWER
*Central Fdry. Co., N. Y. C.
*Clow & Sons., J. B., Chicago, Ill.
*Lynchburg Fdry. Co., Lynchburg, Va.
*U. S. Cast Iron Pipe & Fdry Co., Burlington, N. J.
Casey-Hedges Co., Chattanooga, Tenn.

CAST IRON MANHOLES
*S. E. T. Valve & Hydrant Co., New York.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Madison Fdry Co., Cleveland, O.

CATCH BASINS
*Clark Co., H. W., Mattoon, Ill.
*Clow & Sons., J. B., Chicago, Ill.
*Dee Co., W. E., Chicago, Ill.
*Thompson-Fleming Co., Inc., Buffalo, N. Y.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
*Zieg Mfg. Co., F. B., Fredericktown, O.
Casey-Hedges Co., Chattanooga, Tenn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Madison Fdry Co., Cleveland, O.

CATCH BASIN CLEANING APPARATUS
*Otterson Auto Eductor Co., Springfield, O.
*Springfield Eng. Co., Springfield, O.

CAULKING MACHINERY
*Mueller Mfg. Co., H. Decatur, Ill.
*Smith Mfg. Co., A. P., East Orange, N. J.
Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., N. Y. C.

CAULKING MATERIALS
*Leadite Co, Philadelphia, Pa.
*United Lead Company, New York.

Where to Purchase

CEMENT
*Alpha Portland Cement Co., Easton, Pa.
*Atlas Portland Cement Co., New York.
*Penna. Cement Co., New York.
Ash Grove Lime & Portland Cement Co., Kansas City, Mo.
Canada Cement Co., Ltd., Montreal, Can.
Clinchfield Port. Cem. Corp., Kingsport, Tenn.
Crescent Portland Cement Co., Wampum, Pa.
Dewey Portland Cement Co., Kansas City, Mo.
Dixie Portland Cement Co., Chattanooga, Tenn.
Lehigh Portland Cement Co., Allentown, Pa.
Marquette Cement Mfg. Co., Chicago, Ill.
Portland Cement Assn., Chicago, Ill.
Riverside Portland Cement Co., Los Angeles, Cal.
Sandusky Cement Co., Cleveland, Ohio.
Texas Portland Cement Co., Dallas, Tex.
Universal Portland Cement Co., Chicago, Ill.
Wabash Portland Cement Co., Detroit, Mich.

CEMENT INSPECTION
*Pittsburgh Testing Laboratories, Pittsburgh, Pa.
Hunt & Co., Robert W., Chicago, Ill.

CEMENT MAKING MACHINERY
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Austin Machinery Corp'n., Chicago, Ill.
Fuller-Lehigh Co., Fullerton, Pa.
Vulcan Iron Works, Wilkesbarre, Pa.

CENTRIFUGAL PUMPS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Clark Co., H. W., Mattoon, Ill.
*Delaval Steam Turbine Co., Trenton, N. J.
*Fairbanks, Morse & Co., Chicago, Ill.
*Indiana Air Pump Co., Indianapolis, Ind.
*Lea-Courtenay Co., Newark, N. J.
*United Iron Works Co., Kansas City, Mo.
*Worthington Pump & Mach. Corp., New York.
*Yeomans Bros. Co., Chicago, Ill.
American Well Works, Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Camden Iron Works, Camden, N. J.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
Domestic Engr. & Pump Co., Shippensburg, Pa.
Keystone Driller Co., Beaver Falls, Pa.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Schramm & Son, Inc., Chris. D., Philadelphia, Pa.

CHAINS
*N. Falls Metal Stamp. Wks., Niagara Falls, N. Y.
American Chain Co., Inc., Bridgeport, Conn.
Blaw-Knox Co., Pittsburgh, Pa.
Chain Belt Co., Milwaukee, Wis.
Columbus McKinnon Chain Co., Columbus, O.
Link-Belt Co., Philadelphia, Pa.
Speidel, J. G., Reading, Pa.
Topping Brothers, New York.
Upson-Walton Co., Cleveland, O.
U. S. Chain & Forge Co., Pittsburgh, Pa.

CHAINS, STEEL AND MALLEABLE
Chain Belt Co., Milwaukee, Wis.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Webster Mfg. Co., Tiffin, O.

CHECK VALVES
*Columbian Iron Works, Chattanooga, Tenn.
*Flower Valve Mfg. Co., Detroit, Mich.
*Ludlow Valve Mfg. Co., Troy, N. Y.
*Mueller Mfg. Co., H., Decatur, Ill.
Lunkenheimer Co., Cincinnati, O.

CHEMICALS FOR WATER PURIFICATION
*Du Pont de Nemours & Co., E. I., Wilmington, Del.
*Electro Bleaching Gas Co., New York.
*Hooker Electrochemical Co., New York.
*Mathieson Alkali Works, Inc., N. Y. C.
*Penna. Salt Mfg. Co., Philadelphia, Pa.
General Chemical Co., New York.

CHIMNEYS, CONCRETE
Kellogg & Co., M. W., New York.
Weber Chimney Co., Chicago, Ill.

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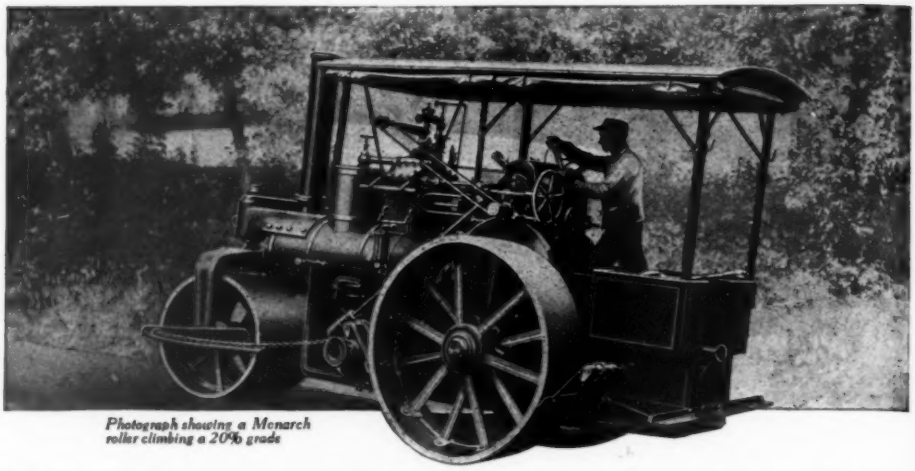

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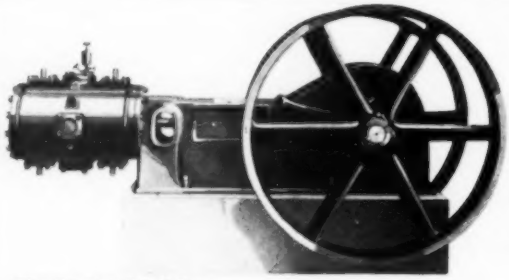

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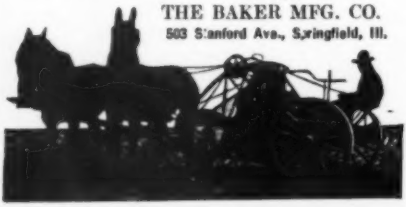

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Horizontal Hydraulic Hoist Co., Milwaukee, Wis.
Lee Loader & Body Co., Chicago, Ill.
Simplex Mfg. Co., Coatesville, Pa.
Wood Hydraulic Hoist & Body Co., Detroit, Mich.

DUMP CARTS AND WAGONS
*Acme Road Machinery Co., Frankfort, N. Y.
*Austin Western Road Mchy. Co., Chicago, Ill.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Tiffin Wagon Co., Tiffin, Ohio.
*Watson Products Corp., Canastota, N. Y.
Austin Mfg. Co., Chicago, Ill.
Eagle Wagon Works, Auburn, N. Y.
Holzbog & Bro., Geo. H., Jeffersonville, Ind.

DUST LAYING COMPOUNDS
*Barrett Co., New York.
*Dustoline for Roads Co., Summit, N. J.
*Standard Oil Co. of Indiana, Chicago, Ill.
*Texas Co., New York City.
Semet-Solvay Co. Solvay, N. Y.

DYNAMITE (See Explosives)

EJECTORS, SEWAGE
*Pacific Flush Tank Co., Chicago, Ill.
*Yeomans Bros. Co., Chicago, Ill.

ELECTRIC CURRENT METERS (See Current Meters)

ELECTRIC GENERATORS AND MOTORS. (See Generators, Electric.)

ELECTRIC LAMPS
*Cutter Works, Geo., South Bend, Ind.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ELECTRIC LIGHTING PLANTS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Triumph Electric Co., Cincinnati, O.
Western Electric Co., New York.
White & Co., J. G., New York.

ELECTRICAL SUPPLIES
*Bissell Co., F., Toledo, O.
*Cutter Works, Geo., South Bend, Ind.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ELECTRIC TRANSFORMERS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*General Electric Co., Schenectady, New York.
*Kuhlman Electric Co., Bay City, Mich.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC WIRES AND CABLES
*American Steel & Wire Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Habirshaw Cable Co., New York.
*Hazard Mfg. Co., Wilkesbarre, Pa.
*Simplex Wire & Cable Co., Boston, Mass.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELEVATORS, BUCKET
*Austin Western Road Machy. Co., Chicago, Ill.
*Haiss Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Worthington Pump & Mchy. Works, New York.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Chain Belt Co., Milwaukee, Wis.
Eastern Road Machy. Co., Chicago, Ill.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Marsh & Co., Geo. C., Chicago, Ill.
Robins Conv. Belt Co., N. Y. C.
Webster Mfg. Co., Tiffin, O.
Weller Mfg. Co., Chicago, Ill.

ELEVATORS, CONTRACTING MATERIAL
*Ransome Concrete Machy. Co., Dunellen, N. J.
American Hoist & Derrick Co., St. Paul, Minn.
Byers Machine Co., J. F., Ravenna, O.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Insley Mfg. Co., Indianapolis, Ind.
Smith Co., T. L., Chicago, Ill.

ELEVATORS, FACTORY
Ridgway & Son Co., C., Coatesville, Pa.
Speidel, J. G., Reading, Pa.
Webster Mfg. Co., Tiffin, O.

ENGINEERS' AND DRAUGHTSMENS' INSTRUMENTS AND SUPPLIES
*Kolesch & Co., New York.
*Weber & Co., F., Philadelphia, Pa.
Aloe Co., A. S., St. Louis, Mo.
Buff & Buff Mfg. Co., Boston, Mass.
Dietzgen Co., E., Chicago, Ill.
Gurley Co., W. & L. E., Troy, N. Y.
Keuffel & Esser Co., Hoboken, N. J.
Lufkin Rule Co., Saginaw, Mich.

ENGINES, GAS AND GASOLINE
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*Foos Gas Engine Co., Springfield, Ohio.
*Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.
*Worthington Pump & Mchy. Corp., New York
C. H. & E. Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., Chicago, Ill.
De La Vergne Mch. Co., New York City.
Domestic Engine & Pump Co., Shippensburg, Pa
Standard Scale & Supply Co., Pittsburgh, Pa
Universal Motor Co., Oshkosh, Wis.
Weber Engine Co., Kansas City, Mo.

ENGINES, HIGH DUTY WATER-WORKS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., Trenton, N. J.
*Fairbanks, Morse & Co., Chicago, Ill.
*Worthington Pump & Mchy. Corp., New York.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.

ENGINES, OIL. (See Oil Engines.)

ENGINES, PUMPING
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Deming Co., Salem, O.
*Fairbanks Morse & Co., Chicago, Ill.
*Nordberg Mfg. Co., Milwaukee, Wis.
*United Iron Wks., Inc., Kansas City, Mo.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
*Worthington Pump & Machy. Corp., New York.
American Gas Engine Co., Kansas City, Mo.
American Well Works, Aurora, Ill.
Dayton-Dowd Co., Quincy, Ill.
Enterprise Mchy. Co., Minneapolis, Minn.
Weinman Pump Mfg. Co., Columbus, O.

Where to Purchase

ENGINES, STEAM
- ***Allis-Chalmers Mfg. Co., Milwaukee, Wis.**
- ***Nordberg Mfg. Co., Milwaukee, Wis.**
- Ball Engine Co., Erie, Pa.
- Dake Engine Co., Grand Haven, Mich.
- Erie Pump & Engine Co., Medina, N. Y.
- Hardie-Tynes Mfg. Co., Birmingham, Ala.
- Leffel Co., J., Springfield, O.
- Morris Machine Works, Baldwinsville, N. Y.
- Murray Iron Works Co., Burlington, Ia.
- Sturtevant Co., B. F., Boston, Mass.

ENGINES, TRACTION
- ***Allis-Chalmers Mfg. Co., Milwaukee, Wis.**
- ***Austin-Western Road Mchy. Co., Chicago, Ill.**
- ***Fairbanks, Morse & Co., Chicago, Ill.**
- Oliver Tractor Co., Knoxville, Tenn.
- Phoenix Mfg. Co., Eau Claire, Wis.

EXCAVATING MACHINERY. (See Names Under Excavators, also Steam Shovels)

EXCAVATORS, CABLEWAY
- Ball Eng. Co., Erie, Pa.
- Blaw-Knox Co., Pittsburgh, Pa.
- Bucyrus Co., South Milwaukee, Wis.
- Byers Machine Co., J. F., Ravenna, O.
- Lidgerwood Mfg. Co., New York.
- Marion Steam Shovel Co., Marion, O.
- Smith Co., T. L., Chicago, Ill.

EXCAVATORS, DITCH AND TRENCH
- ***Baker Mfg. Co., Springfield, Ill.**
- ***Pawling & Harnischfeger Co., Milwaukee, Wis.**
- ***Russell Grader Mfg. Co., Minneapolis, Minn.**
- American Hoist & Derrick Co., St. Paul, Minn.
- Austin Machinery Corp'n., Chicago, Ill.
- Ball Engine Co., Erie, Pa.
- Bay City Dredge Works, Bay City, Mich.
- Buckeye Traction Ditcher Co., Findlay, O.
- Bucyrus Co., South Milwaukee, Wis.
- Byers Machine Co., J. F., Ravenna, O.
- Clyde Iron Works, Duluth, Minn.
- Fairbanks Steam Shovel Co., Marion, O.
- Hayward Co., The, New York City.
- Keystone Driller Co., Beaver Falls, Pa.
- Marion Steam Shovel Co., Marion, O.
- Monighan Machine Co., Chicago, Ill.
- Osgood Co., Marion, O.
- Parsons Co., Newton, Ia.

EXCAVATORS, DRAG-LINE
- ***Pawling & Harnischfeger Co., Milwaukee, Wis.**
- Austin Machinery Corp'n., Chicago, Ill.
- Bucyrus Co., South Milwaukee, Wis.
- Byers Machine Co., J. F., Ravenna, O.
- Clyde Iron Works, Duluth, Minn.
- Hayward Co., New York.
- Industrial Works, Bay City, Mich.
- Link-Belt Co., Chicago, Ill.
- Marion Steam Shovel Co., Marion, O.
- Marsh & Co., G. C., Chicago, Ill.
- Monighan Machine Co., Chicago, Ill.
- Osgood Co., Marion, O.
- Parsons Co., Newton, Ia.
- Smith Co., T. L., Chicago, Ill.

EXPANDED METAL
- ***Truscon Steel Co., Youngstown, O.**
- Berger Mfg. Co., Canton, O.
- Consolidated Expanded Metal Co., Braddock, Pa.
- Corrugated Bar Co., Inc., Buffalo, N. Y.
- Northwestern Expanded Metal Co., Chicago, Ill.

EXPANSION JOINT MATERIAL
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Barrett Co., New York.**
- ***Pioneer Asphalt Co., Lawrenceville, Ill.**
- ***Texas Company, New York.**
- ***Truscon Steel Co., Youngstown, O.**
- National Steel Fabric Co., Pittsburgh, Pa.
- Waring-Underwood Co., Philadelphia, Pa.

EXPLOSIVES
- ***Du Pont de Nemours & Co., E. I., Wilmington, Del.**
- Ætna Explosives Co., Inc., New York.
- Atlas Powder Co., Philadelphia, Pa.
- Hercules Powder Co., Wilmington, Del.

FENCING
- ***American Steel & Wire Co., Chicago, Ill.**
- ***Stewart Iron Works Co., Cincinnati, O.**
- Anchor Post Iron Works, New York.
- Cyclone Fence Co., Waukegan, Ill.
- Frost-Superior Fence Co., Cleveland, O.
- Indiana Steel & Wire Co., Muncie, Ind.
- Pittsburgh Steel Co., Pittsburgh, Pa.
- Wickwire-Spencer Steel Corp'n, Worcester, Mass.

FILING EQUIPMENT, STEEL
- ***Econ. Drawing Table & Mfg. Co., Adrian, Mich.**
- Art Metal Constr. Co., Jamestown, N. Y.
- Berger Mfg. Co., Canton, O.
- Van Dorn Iron Works, Cleveland, O.

FILTERS, OIL
- ***Bowser & Co., Inc., S. F., Fort Wayne, Ind.**
- Wayne Oil Tank & Pump Co., Ft. Wayne, Ind.

FILTERS, WATER
- ***N. Y. Continental Jewel Filtr. Co., Nutley, N. J.**
- ***Norwood Engineering Co., Florence, Mass.**
- ***Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.**
- American Water Softener Co., Philadelphia, Pa.
- International Filter Co., Chicago, Ill.
- Permutit Co., New York.
- Roberts Filter Mfg. Co., Darby, Pa.
- Scaife & Sons Co., W. B., Pittsburgh, Pa.

FIRE EXTINGUISHERS, CHEMICAL
- ***American-La France Fire Eng. Co., Elmira, N. Y.**
- ***O. J. Childs Co., Utica, N. Y.**
- ***Grinnell Co., Providence, R. I.**
- C. J. Cross Mfg. Co., Inc., New York.
- Foamite Firefoam Co., New York.
- Pyrene Mfg. Co., New York.

FIREPROOF BUILDING MATERIAL
- ***Truscon Steel Co., Youngstown, O.**
- Berger Mfg. Co., Canton, O.
- Corrugated Bar Co., Inc., Buffalo, N. Y.
- Detroit Steel Prod. Co., Detroit, Mich.
- General Fireproofing Co., Youngstown, O.
- Keasbey & Mattison Co., Ambler, Pa.
- Kinnear Mfg. Co., Columbus, O.
- National Fireproofing Co., Pittsburgh, Pa.

FIRST AID EQUIPMENT
- ***American-LaFrance Fire Eng. Co., Elmira, N. Y.**

FLEXIBLE JOINTS
- ***Central Foundry Co., New York.**
- ***Coldwell-Wilcox Co., Newburgh, N. Y.**
- ***Crane Co., Chicago, Ill.**
- ***United Lead Company, New York.**
- ***U. S. C. I. Pipe & Fdry Co., Burlington, N. J.**
- Lunkenheimer Co., Cincinnati, O.

FLOORS, WOOD BLOCK
- ***Barrett Co., New York.**
- ***Republic Creosoting Co., Indianapolis, Ind.**
- Jennison-Wright Co., Toledo, O.
- Southern Wood Pres. Co., Atlanta, Ga.

FLUSH TANKS
- ***Pacific Flush Tank Co., New York.**

FLUSHERS, STREET
- ***Kinney Mfg. Co., Boston, Mass.**
- ***Municipal Supply Co., South Bend, Ind.**
- ***Tiffin Wagon Co., Tiffin, O.**
- Etnyre, E. D., & Co., Oregon, Ill.

FORGES
- Buffalo Forge Co., Buffalo, N. Y.
- Carpenter & Co., Geo. B., Chicago, Ill.
- Hauck Mfg. Co., New York.
- Ingersoll-Rand Co., New York.

FORM CLAMPS
- Insley Mfg. Co., Indianapolis, Ind.
- Marion Malleable Iron Works, Marion, Ind
- Universal Clamp Co., Chicago, Ill.

FORMS, CONSTRUCTION
- ***Heltzel Steel Form & Iron Co., Warren, O.**
- ***Truscon Steel Co., Detroit, Mich.**
- Blaw-Knox Co., Pittsburgh, Pa.
- Foote Conc. Mchy. Co., Chicago, Ill.
- Hydraulic Steelcraft Co., Cleveland, O.

Where to Purchase

FORMS FOR WALLS, BUILDING CONSTRUCTION
*Hetzel Steel Form & Iron Co., Warren, O.
*Truscon Steel Co., Detroit, Mich.
Blaw-Knox Co., Pittsburgh, Pa.
Hydraulic Steelcraft Co., Cleveland, O.

FOUNTAINS. (See Drinking Fountains.)

FURNITURE AND FILES, STEEL
Art Metal Constn. Co., Jamestown, N. Y.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works, Cleveland, O.

GARBAGE DISPOSAL
*Destructor Co., New York.
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
Decarie Incinerator Co., Minneapolis, Minn.
Jeffrey Manufacturing Co., Columbus, O.
Morse-Boulger Destructor Co., New York.
Stacey Bates Co., Minneapolis, Minn.

GARBAGE WAGONS
*Austin Western Road Mchy. Co., Chicago, Ill.
*Autocar Co., Ardmore, Pa.
*Federal Motor Truck Co., Detroit, Mich.
*Four Wheel Drive Auto Co., Clintonville, Wis.
*Service Motor Truck Co., Wabash, Ind.
*Tiffin Wagon Co., Tiffin, O.
*Watson Products Corp., Canastota, N. Y.
*White Co., Cleveland, O.
Holzbog & Bro., Geo. H., Jeffersonville, Ind.

GAS ENGINES. (See Engines, Gas and Gasoline.)

GAS METERS
*Builders Iron Foundry, Providence, R. I.
*General Electric Co., Schenectady, New York.
*Pittsburg Meter Co., East Pittsburgh, Pa.

GAS PRODUCERS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Camden Iron Works, Camden, N. J.

GASOLINE PUMPING ENGINES
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*Waldo Bros. & Bond Co., Boston, Mass.
*Worthington Pump & Mchy. Corp., New York.
American Well Works, Aurora, Ill.

GASOLINE STORAGE TANKS
*Bowser & Co., Inc., S. F., Fort Wayne, Ind.
*Chicago Bridge & Iron Works, Chicago, Ill.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
*United Iron Works, Kansas City, Mo.
Biggs Boiler Works, Akron, Ohio.
Byers Mach. Co., J. F., Ravenna, Ohio.
Scaife & Sons, Wm. B., Oakmont, Pa.
Wayne Oil Tank & Pump Co., Ft. Wayne, Ind.

GATES, SLUICE
*Coldwell-Wilcox Co., Newburgh, N. Y.
*Columbian Iron Works, Chattanooga, Tenn.
*Crane Co., Chicago, Ill.
*Eddy Valve Co., Waterford, N. Y.
*Flower Valve Co., Detroit, Mich.
*Kennedy Valve Mfg. Co., Elmira, N. Y.
*Ludlow Valve Mfg. Co., Troy, N. Y.
*Rensselaer Valve Co., Troy, N. Y.
*Wood & Co., R. D., Philadelphia, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Coffin Valve Co., Boston, Mass.
Hardesty Mfg. Co., R., Denver, Col.

GAUGES, RECORDING, PRESSURE, STEAM
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Ashton Valve Co., Boston, Mass.
Bristol Co., Waterbury, Conn.
Crosby Steam Gauge & Valve Co., Boston, Mass.
Fairbanks Company, New York.
Marsh & Co., Jas. P., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
U. S. Gauge Co., New York.

GAUGES, WATER
*Clow & Sons, J. B., Chicago, Ill.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Ashton Valve Co., Boston, Mass.
Bristol Co., Waterbury, Conn.
Lunkenheimer Co., Cincinnati, O.
United States Gauge Co., New York.
Walworth Mfg. Co., Boston, Mass.

GAUGES, SURFACE, RESERVOIR AND SPECIAL WATER-WORKS
*Builders Iron Foundry, Providence, R. I.
*Clark Co., H. W., Mattoon, Ill.
*Simplex Valve & Meter Co., Philadelphia, Pa.

GENERATORS, ELECTRIC
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Gregory Electric Co., Chicago, Ill.
Ideal Elec. & Mfg. Co., Mansfield, O.
Triumph Electric Co., Cincinnati, O.
Western Electric Co., New York.

GLASS, FIREPROOF. (See Wire Glass.)

GRADERS, ROAD
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Good Roads Mchy. Co., Philadelphia, Pa.
*Koehring Machine Co., Milwaukee, Wis.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Union Iron Prod. Co., East Chicago, Ind.
*Zieg Mfg. Co., F. B., Fredericktown, O.
Case Threshing Machine Co., J. I., Racine, Wis.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Port Huron Eng. & Thresh. Co., Pt. Huron, Mich.

GRINDERS AND SAND RAMMERS
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, Ohio.
Ingersoll-Rand Co., New York, N. Y.
Sullivan Machinery Co., Chicago, Ill.

GYPSUM PRODUCTS
U. S. Gypsum Co., Chicago, Ill.

HAMMERS, STEAM, PILE. (See Pile Hammers, Steam.)

HEATING KETTLES. (See Kettles)

HOISTS, BELT-DRIVEN
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Mfg. Co., New York.
Mundy Hoisting Engine Co., J. S., Newark, N. J.

HOISTS, CONCRETE, TOWER
*Ransome Concrete Machy. Co., Dunellen, N. J.
Clyde Iron Works, Duluth, Minn.
Flory Mfg. Co., S. Bangor, Pa.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
National Hoisting Engine Co., Harrison, N. J.

HOISTS, CONTRACTORS', ELECTRIC
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
American Hoist & Derrick Co., St. Paul, Minn.
Byers Machine Co., J. F., Ravenna, O.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Clyde Iron Works, Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Flory Mfg. Co., S., Bangor, Pa.
Ingersoll-Rand Co., New York.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Northern Eng. Works, Detroit, Mich.

HOISTS, CONTRACTORS', GASOLINE
*Waldo Bros. & Bond Co., Boston, Mass.
American Cement Mach. Co., Keokuk, Ia.
Austin Mach. Corp., Chicago, Ill.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Clyde Iron Works, Duluth, Minn.
Domestic Engine & Pump Co., Shippensburg, Pa.
Flory Mfg. Co., S., Bangor, Pa.
Lansing Co., Lansing, Mich.
Lidgerwood Mfg. Co., New York.
Monighan Machine Co., Chicago, Ill.
Mundy Hoisting Engine Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
O. K. Clutch & Mach. Co., Columbia, Pa.
Schramm & Son, Inc., Chris. D., Philadelphia, Pa.
Standard Scale & Supply Co., Pittsburgh, Pa.

Where to Purchase

HOISTS, CONTRACTORS', STEAM
American Hoist & Derrick Co., St. Paul, Minn.
Austin Mach. Corp., Chicago, Ill.
Byers Machine Co., J. F., Ravenna, O.
Clyde Iron Works, Duluth, Minn.
Flory Mfg. Co., S., Bangor, Pa.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.

HOISTS, PNEUMATIC
*Worthington Pump & Mchy. Corp., New York.
Chicago Pneumatic Tool Co., Chicago, Ill.
Detroit Hoist & Machine Co., Detroit, Mich.
Flory Mfg. Co., Bangor, Pa.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.

HOLLOW TILE
National Fireproofing Co., Pittsburgh, Pa.

HOPPERS, CONCRETE
*Koehring Mach. Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
*Ransome Concrete Machy. Co., Dunellen, N. J.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

HOSE, AIR
*Goodyear Tire & Rubber Co., Akron, O.
*U. S. Rubber Co., New York.
Cincinnati Rubber Mfg. Co., Cincinnati, O.
Ingersoll-Rand Co., New York.
Penna. Flexible Metallic Tubing Co., Phila., Pa.

HOUSES, PORTABLE. (See Buildings, Portable)

HYDRANTS, FIRE
*Clark Co., H. W., Mattoon, Ill.
*Columbian Iron Works, Chattanooga, Tenn.
*Eddy Valve Mfg. Co., Waterford, N. Y.
*Kennedy Valve Mfg. Co., Elmira, N. Y.
*Ludlow Valve Mfg. Co, Troy, N. Y.
*Norwood Engineering Co, Florence, Mass.
*Rensselaer Valve Co., Troy, N. Y.
*Smith Mfg. Co., A. P., East Orange, N. J.
*Wood & Co., R. D., Philadelphia, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Darling Valve Mfg. Co., Williamsport, Pa.
Iowa Valve Co., Oskaloosa, Ia.

INCINERATORS, GARBAGE. (See Garbage Disposal)

INDICATOR POSTS. (See Valves)

INSPECTING LABORATORIES
*Conard & Buzby, Burlington, N. J.
*Pittsburgh Testing Laboratories, Pittsburgh, Pa.
Allentown Testing Laboratories, Allentown, Pa.

INSTRUMENTS, SURVEYING
*Kolesch & Co., New York.
*Weber & Co., F., Philadelphia, Pa.
Ainsworth & Sons, Wm., Denver, Col.
Bausch & Lomb Optical Co., Rochester, N. Y.
Berger & Sons, C. L., Boston, Mass.
Brandis & Sons Mfg. Co., Brooklyn, N. Y.
Buff & Buff Mfg. Co., Boston, Mass.
Dietzgen Co., Eugene, Chicago, Ill.
Gurley, W. & L. E., Troy, N. Y.
Keuffel & Esser Co., Hoboken, N. J.
Leitz Co., A., San Francisco, Cal.
Pfister, Wm. H., Cincinnati, O.
White Co., David, Milwaukee, Wis.

INSULATING MATERIAL
*Bissell Company, F., Toledo, O.
*Carey Company, Philip, Cincinnati, O.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Continental Fibre Co., Newark, Del.
Johns-Manville Co., H. W., New York.
Standard Paint Co., New York.

INSULATED WIRE AND CABLE
*General Electric Co., Schenectady, N. Y.
*Habirshaw Electric Cable Co., Inc., New York.
*Hazard Mfg. Co., Wilkesbarre, Pa.
*U. S. Rubber Co., New York.
*Simplex Wire & Cable Co., Boston, Mass.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

IRON WORK, STRUCTURAL AND ORNAMENTAL (See Bridges and Buildings)

JACKS, LIFTING
*McKiernan-Terry Drill Co., New York.
Buda Company, Chicago, Ill.
Duff Mfg. Co., Pittsburgh, Pa.
Joyce-Cridland Co., Dayton, O.
Kalamazoo Railway Supply Co., Kalamazoo, Mich
Norton, Inc., A. O., Boston, Mass.
Watson-Stillman Company, New York.

JACKS, PIPE FORCING
*Clark Co., H. W., Mattoon, Ill.
Duff Mfg. Co., Pittsburgh, Pa.

JOINTS, EXPANSION PAVING
*Barrett Company, New York.
*Carey Company, Philip, Cincinnati, O.
*Truscon Steel Co., Youngstown, O.
Waring-Underwood Co., Philadelphia, Pa.

JOINTS, FLEXIBLE PIPE. (See Flexible Joints.)

KETTLES, FOR ASPHALT AND TAR HEATING
*Acme Road Mach. Co., Frankfort, N. Y.
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Good Roads Machinery Co., Kennett Square, Pa.
*Littleford Bros., Cincinnati, O.
Macleod Co., Cincinnati, O.

LATH, METAL
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Consol. Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
General Fireproofing Co., Youngstown, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
Northwestern Expanded Metal Co., Chicago, Ill.
Wickwire-Spencer Steel Corp., Worcester, Mass.

LEAK FINDERS
*Clark & Co., H. W., Mattoon, Ill.
*Pitometer Company, New York.

LETTERS AND FIGURES, METAL
*Niagara Falls Met. Stamp. Wks., Niagara Falls, N. Y.

LIGHTS, CONTRACTORS
*General Elec. Co., Schenectady, N. Y.
Carbic Mfg. Co., Duluth, Minn.
Macleod Co., Cincinnati, O.
Milburn Co., Alex., Baltimore, Md.
Prest-O-Lite Co., Inc., New York.

LIGHTING STANDARDS
*Clow & Sons, J. B., Chicago, Ill.
*Cutter Works, Geo., South Bend, Ind.
*Electric Railway Equip. Co., Cincinnati, O.
*King Mfg. Co., Chicago, Ill.
*Stewart Iron Works, Cincinnati, O.
Union Metal Mfg. Co., Canton, O.

LIQUID CHLORINE
*Electro Bleaching Gas Co., New York.
*Hooker Electrochemical Co., New York.
*Mathieson Alkali Works, Inc., New York.
*Penna. Salt Mfg. Co., Philadelphia, Pa.

LOADERS, GRAVEL AND WAGON
*Haiss Mfg. Co., Geo., New York.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Atlas Engineering Co., Milwaukee, Wis.
Austin Machinery Corp'n., Chicago, Ill.
Barber-Greene Co., Aurora, Ill.
Bay City Dredge Works, Bay City, Mich.
Bonney Supply Co., Inc., Rochester, N. Y.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Lee Loader & Body Co., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Portable Mchy. Co., Passaic, N. J.
Sackett Screen & Chute Co., H. B., Chicago, Ill.
Sauerman Bros., Chicago, Ill.
Smith Co., T. L., Chicago, Ill.

Where to Purchase

LOCK BAR STEEL PIPE
*East Jersey Pipe Co., New York

LOCKERS, STEEL
*Medart Mfg. Co., Fred., St. Louis, Mo.
Hart & Hutchinson Co., New Britain, Conn.

LOCOMOTIVES, INDUSTRIAL
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Austin Mach. Corp., Chicago, Ill.
Baldwin Locomotive Works, Philadelphia, Pa.
Davenport Locomotive Works, Davenport, Ia.
Easton Car & Constr. Co., Easton, Pa.
Hoisting Mchy. Co., New York.
Koppel Industrial Car & Equip. Co., Koppel, Pa.
Machinery Sales Co., Chicago, Ill.
Marsh & Co., G. C., Chicago, Ill.
Porter Co., H. K., Pittsburgh, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.
Whitcomb Co., Geo. D., Rochelle, Ill.

LUMBER, HEAVY CONSTRUCTION
Brown Co., Portland, Me.
Crowell & Spencer Lumber Co., Long Leaf, La.
Great Southern Lumber Co., Bogalusa, La.
Industrial Lumber Co., Elizabeth, La.
Long Bell Lumber Co., Kansas City, Mo.
Trexler Lumber Co., Newark, N. J.

LUMBER, METAL
*Truscon Steel Co., Detroit, Mich.
Berger Mfg. Co., Canton, O.
General Fireproofing Co., Youngstown, O.
National Pressed Steel Co., Massillon, O.
Northwestern Exp. Metal Co., Chicago, Ill.

MANHOLE COVERS
*Bissell Co., F., Toledo, O.
*Central Foundry Co., New York.
*Clark Co., H. W., Mattoon, Ill.
*Clow & Sons, J. B., Chicago, Ill.
*Dee Co., Wm. E., Chicago, Ill.
*S. E. T. Valve & Hydrant Co., New York.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Sessions Foundry Co., Bristol, Conn.

METER BOXES
*Clark Co., H W., Mattoon, Ill.
*Clow & Sons, J. B., Chicago, Ill.
*Columbian Iron Works, Chattanooga, Tenn.
*Ford Meter Box Co., Wabash, Ind.
*McNutt Meter Box Co., Brazil, Ind.
*Mueller Mfg. Co., H., Decatur, Ill.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*S. E. T. Valve & Hydrant Co., New York.

METER COUPLINGS
*Clark Co., H. W., Mattoon, Ill.
*Ford Meter Box Co., Wabash, Ind.
*McNutt Meter Box Co., Brazil, Ind.
*Mueller Mfg. Co., H., Decatur, Ill.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*Union Water Meter Co., Worcester, Mass.

METER TESTERS
*Buffalo Meter Co., Buffalo, N. Y.
*Clark Co., H. W., Mattoon, Ill.
*Ford Meter Box Co., Wabash, Ind.
*Mueller Mfg. Co., H., Decatur, Ill.
*National Meter Co., New York.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.

METERS, WATER & OIL
*Badger Meter Mfg. Co., Milwaukee, Wis.
*Builders Iron Fdry., Providence, R. I.
*Buffalo Meter Co., Buffalo, New York.
*Clark Co., H. W., Mattoon, Ill.
*Gamon Meter Co., Newark, N. J.
*Hersey Mfg. Co., Boston, Mass.
*National Meter Co., New York.
*Neptune Meter Co., E. Pittsburgh, Pa.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*Simplex Valve & Meter Co., Philadelphia, Pa.
*Thomson Meter Co., Brooklyn, N. Y.
*Union Water Meter Co., Worcester, Mass.
*Worthington Pump & Mchy. Corp., New York.

MIXERS, CONCRETE. **(See Concrete Mixers.)**

MIXERS, GROUT
American Cement Mchy. Co., Keokuk, Ia.
Lakewood Engineering Co., Cleveland, O.
Union Iron Works, Inc., Hoboken, N. J.

MIXERS, HOT
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Koehring Machine Co., Milwaukee, Wis.
Austin Machinery Corp'n., Chicago, Ill.

MIXERS, MORTAR
*Ransome Concrete Machy. Co., Dunellen, N. J.
American Cement Machine Co., Keokuk, Ia.
Austin Machinery Corp'n., Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Knickerbocker Co., Jackson, Mich.
Lansing Co., Lansing, Mich.
Lakewood Engineering Co., Cleveland, Ohio.
Smith Co., T. L., Chicago, Ill.
Standard Scale & Supply Co., Pittsburgh, Pa.
Waterloo Const. Mach. Co., Waterloo, Ia.

MOTORS
*Allis Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Ingersoll Rand Co., New York.
Triumph Electric Co., Cincinnati, O.

MOTOR FIRE APPARATUS
*American-LaFrance Fire Eng. Co., Elmira, N. Y
*Childs Co., O. J., Utica, N. Y.
Ahrens-Fox Fire Engine Co., Cincinnati, O.
Seagrave Co., Columbus, O.

MOTOR TRUCKS
*American-LaFrance Fire Eng. Co., Elmira, N. Y.
*Autocar Co., Ardmore, Pa.
*Couple Gear Fght. Wheel Co., Gr. Rapids, Mich.
*Federal Motor Truck Co., Detroit, Mich.
*General Motors Truck Co., Pontiac, Mich.
*International Motor Co., New York.
*Packard Motor Car Co., Detroit, Mich.
*Selden Truck Corp'n., Rochester, N. Y.
*Service Motor Truck Co., Wabash, Ind.
*Tiffin Wagon Co., Tiffin, O.
*White Co., Cleveland, Ohio.
Acme Motor Truck Co., Cadillac, Mich.
Brockway Motor Truck Co., Cortland, N. Y.
Clydesdale Motor Truck Co., Clyde, O.
Denby Motor Truck Co., Detroit, Mich.
Four Wheel Drive Auto Co., Clintonville, Wis.
Garford Motor Truck Co., Lima, O.
Gramm Bernstein Motor Truck Co., Lima, O.
Jackson Motors Corp'n., Jackson, Mich.
Kelly Springfield Motor Truck Co., Springfield, O.
Kissel Motor Car Co., Hartford, Wis.
Nash Motors Co., Kenosha, Wis.
Nelson Motor Truck Co., Saginaw, Mich.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Republic Motor Truck Co., Alma, Mich.
Sterling Motor Truck Co., Milwaukee, Wis.
Stewart Motor Corp'n., Buffalo, N. Y.
U. S. Motor Truck Co., Cincinnati, O.
Watson Products Corp'n., Canastota, N. Y.
Wilson Co., J. C., Detroit, Mich.

MOULDS, CONCRETE
Blaw-Knox Co., Pittsburgh, Pa.
Hydraulic Steelcraft Co., Cleveland, O.

OIL ENGINES
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Bush-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
*Fairbanks, Morse & Co., Chicago, Ill.
*Nordberg Mfg. Co., Milwaukee, Wis.
*Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
*Worthington Pump & Mchy. Corp., New York.
Advance Rumley Thresher Co., La Porte, Ind.
Bessemer Gas Eng. Co., Grove City, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
De La Vergne Machine Co., New York.
Foos Gas Engine Co., Springfield, O.
Ingersoll-Rand Co., New York.
International Harvester Co. of Am., Chicago, Ill
Machinery Sales Co., Chicago, Ill.
Midwest Engine Co., Indianapolis, Ind.
Weber Engine Co., Kansas City, Mo.

Where to Purchase

OIL, ROAD
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Barrett Co., New York.**
- ***Pioneer Asphalt Co., Lawrenceville, Ill.**
- ***Standard Oil Co. of Indiana, Chicago, Ill.**
- ***Texas Company, New York.**
- Atlantic Refining Co., Philadelphia, Pa.
- Headley Good Roads Co., Philadelphia, Pa.
- Pierce Oil Corp., New York.
- Standard Oil Co. of N. J., Newark, N. J.
- U. S. Asphalt Refining Co., New York.

OIL TANKS
- ***Bowser & Co., S. F., Fort Wayne, Ind.**
- ***Chicago Bridge & Iron Works, Chicago, Ill.**
- ***Connery & Co., Inc., Philadelphia, Pa.**
- ***Heil Co., Milwaukee, Wis.**
- ***Pacific Tank & Pipe Co., San Francisco, Cal.**
- ***Littleford Bros., Cincinnati, O.**
- ***Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.**
- ***United Iron Works, Inc., Kansas City, Mo.**
- Biggs Boiler Works Co., Akron, O.
- Chatta. Boiler & Tank Co., Chattanooga, Tenn.
- Chicago Bridge & Iron Works, Chicago, Ill.
- Dover Boiler Works, Dover, N. J.
- Fouts Co., C. C., Middletown, O.
- Petroleum Iron Works Co., Sharon, Pa.
- Riter-Conley Co., Pittsburgh, Pa.
- Scaife & Sons Co., Wm. B., Pittsburgh, Pa.
- Walsh & Weidner Boiler Co., Chattanooga, Tenn.
- Wayne Oil Tank & Pump Co., Ft. Wayne, Ind.

PACKING, WATER PIPE
- ***Leadite Co., The, Philadelphia, Pa.**
- ***Union Water Meter Co., Worcester, Mass.**
- ***United Lead Company, New York.**
- Green, Tweed & Co., New York.

PAINTS, METAL PROTECTION
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Barrett Co., New York.**
- ***Dixon Crucible Co., Jos., Jersey City, N. J.**
- ***Du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.**
- Berry Bros., Detroit, Mich.
- Besley & Co., Chicago, Ill.
- Carbolineum Wood Preserving Co., New York.
- Cook Paint Co., Kansas City, Mo.
- Detroit Graphite Co., Detroit, Mich.
- Longman & Martinez, New York.
- Minwax Co., New York.
- Semet-Solvay Co., Syracuse, N. Y.
- Sherwin-Williams Co., Cleveland, O.
- Sonneborn Sons, Inc., L., New York.
- Standard Paint Co., New York.
- Toch Bros., New York.

PAPERS, BLUE PRINT AND BROWN PRINT
- Indianapolis Blue Print & Supply Co., Indianapolis, Ind.

PAPER, BUILDING, ROOFING, ETC.
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Barrett Co., New York.**
- ***Carey Co., Philip, Cincinnati, O.**
- Berlin Mills Co., Portland, Me.
- Bird & Son, E. Walpole, Mass.
- Hydrex Felt & Eng. Co., New York.
- Johns-Manville Co., H. W., New York.
- National Roofing Co., Tonawanda, N. Y.
- Standard Paper Co., New York.

PAVING BLOCKS, CREOSOTED WOOD
- ***Republic Creosoting Co., Youngstown, O.**
- American Creosote Wks., Inc., New Orleans, La.
- Carbolineum Wood Preserving Co., New York.
- Jennison-Wright Co., Toledo, O.
- Southern Wood Pres. Co., Atlanta, Ga.
- Wyckoff Pipe & Creosoting Co., New York.

PAVING BRICK
- ***Dee Company, Wm. E., Chicago, Ill.**
- ***Metropolitan Paving Brick Co., Canton, O.**
- ***National Paving Brick Mfrs. Assn., Cleveland, O.**
- ***Southern Clay Mfg. Co., Chattanooga, Tenn.**
- Alton Brick Co., Alton, Ill.
- Purington Paving Brick Co., Galesburg, Ill.

PAVING MACHINERY
- ***Austin-Western Road Mchy. Co., Chicago, Ill.**
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Buffalo-Springfield Roller Co., Springfield, O.**
- ***Equitable Asphalt Main. Co., Kansas City, Mo.**
- ***Erie Machine Shops, Erie, Pa.**
- ***Koehring Machine Co., Milwaukee, Wis.**
- Atlas Engineering Co., Milwaukee, Wis.
- Austin Mach. Corp., Chicago, Ill.
- Cummer & Son Co., F. D., Cleveland, O.
- East Iron & Machine Co., Lima, O.
- Lakewood Engineering Co., Cleveland, O.
- Waterloo Const. Mach. Co., Waterloo, Ia.

PAVING MATERIALS
- ***Atlantic Refining Co., Philadelphia, Pa.**
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Barrett Co., New York.**
- ***Carey Co., Philip, Cincinnati, O.**
- ***Standard Oil Co. of Indiana, Chicago, Ill.**
- ***Texas Company, New York.**
- ***Warren Bros. Co., Boston, Mass.**
- Bitoslag Paving Co., New York.
- Robertson Co., H. H., Pittsburgh, Pa.
- Standard Oil Co. of N. J., Newark, N. J.

PAVING MIXERS. **(See Concrete Mixers)**

PAVING TOOLS
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Connery & Co., Inc., Philadelphia, Pa.**
- ***Littleford Bros. Co., Cincinnati, O.**
- ***Warren Bros. Co., Boston, Mass.**
- Anderson Tool & Sup. Co., W. H., Detroit, Mich.
- Carpenter & Co., Geo. B., Chicago, Ill.
- Kramer Bros. Fdry. Co., Dayton, O.
- Union Iron Works, Hoboken, N. J.

PERFORATED METALS
- ***Allis-Chalmers Mfg. Co., Milwaukee, Wis.**

PICKS
- Evansville Tool Works, Evansville, Ind.
- Hubbard Co., Pittsburgh, Pa.
- Iron City Tool Works, Pittsburgh, Pa.
- Klein-Logan Co., Pittsburgh, Pa.
- Plumb, Fayette R., Philadelphia, Pa.
- Verona Tool Works, Verona, Pa.
- Warren Tool & Forge Co., Warren, O.
- Warwood Tool Co., Wheeling, W. Va.

PILE DRIVERS
- ***McKiernan-Terry Drill Co., New York.**
- Browning Co., Cleveland, O.
- Bucyrus Co., So. Milwaukee, Wis.
- Clyde Iron Works, Duluth, Minn.
- Industrial Works, Bay City, Mich.
- Lidgerwood Manufacturing Co., New York.
- McMyler Interstate Co., Cleveland, O.
- Union Iron Works, Hoboken, N. J.

PILE HAMMERS, STEAM
- ***McKiernan-Terry Drill Co., New York.**
- Union Iron Works, Hoboken, N. J.
- Vulcan Iron Works, Chicago, Ill.

PILING, INTERLOCKING STEEL
- Carnegie Steel Co., Pittsburgh, Pa.
- Jones & Laughlin Steel Co., Pittsburgh, Pa.
- Lackawanna Steel Co., Buffalo, N. Y.

PIPE, CAST IRON
- ***Builders Iron Foundry, Providence, R. I.**
- ***Central Foundry Co., New York.**
- ***Clow & Sons, J. B., Chicago, Ill.**
- ***U. S. Cast Iron Pipe & Fdy. Co., Burlington, N.J.**
- ***Warren Fdry. & Machine Co., New York.**
- ***Wood & Co., R. D., Philadelphia, Pa.**
- Fox & Co., John, New York.

PIPE, CORR. METAL
- ***Newport Culvert Co., Newport, Ky.**
- Canton Culvert & Silo Co., Canton, O.
- Hardesty Mfg. Co., Denver, Col.

PIPE, LEAD
- ***United Lead Company, New York.**

PIPE, REINFORCED CONCRETE
- Lock Joint Pipe Co., E. Orange, N. J.

Where to Purchase

PIPE, RIVETED STEEL
*Connery & Co., Inc., Philadelphia, Pa.
*East Jersey Pipe Co., New York.
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.
Canton Culvert & Silo Co., Canton, O.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Hammond Iron Works, Warren, Pa.
Hardesty Mfg. Co., R., Denver, Col.
Littleford Bros., Cincinnati, O.
Petroleum Iron Works Co., Sharon, Pa.
Tippet & Wood, Phillipsburg, N. J.

PIPE, SPIRAL RIVETED
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.

PIPE STEEL
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE, WOOD
*American Wood Pipe Co., Tacoma, Wash.
*Continental Pipe Mfg. Co., Seattle, Wash.
*Pacific Tank & Pipe Co., San Francisco, Cal.
*Redwood Mfrs. Co., San Francisco, Cal.
Michigan Pipe Co., Bay City, Mich.
Standard Wood Pipe Co., Williamsport, Pa.
Wyckoff & Sons Co., A., Elmira, N. Y.

PIPE, WROUGHT IRON
Byers Co., A. M., Pittsburgh, Pa.
Reading Iron Co., Reading, Pa.

PIPE COVERING
*Carey Co., Philip, Cincinnati, O.
*Continental Pipe Mfg. Co., Seattle, Wash.
*Pacific Tank & Pipe Co., San Francisco, Cal.
*Redwood Mfrs. Co., San Francisco, Cal.
Magnesia Assn. of America, Philadelphia, Pa.
Michigan Pipe Co., Bay City, Mich.
Standard Wood Pipe Co., Williamsport, Pa.
Wyckoff & Sons Co., A., Elmira, N. Y.

PIPE CUTTERS. **(See Cutters, Pipe, Hand.)**

PIPE FITTINGS
*American C. I. Pipe Co., Birmingham, Ala.
*American Pipe Bending Mch. Co., Boston, Mass.
*Builders Iron Fdry. Co., Providence, R. I.
*Central Foundry Co., New York.
*Clow & Sons, J. B., Chicago, Ill.
*Crane Co., Chicago, Ill.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
*Wood & Co., R. D., Philadelphia, Pa.
Lunkenheimer Co., Cincinnati, O.

PIPE HANDLING MACHINERY
*Mueller Mfg. Co., H., Decatur, Ill.
*Taylor Portable Steel Derrick Co., Chicago, Ill.

PIPE JOINT COMPOUND, SEWER
*Carey Co., Philip, Cincinnati, O.
*Dixon Crucible Co., J., Jersey City, N. J.
*Leadite Company, Inc., Philadelphia, Pa.
*Pacific Flush Tank Co., New York.
Standard Paint Co., New York.
Waring-Underwood Co., Philadelphia, Pa.

PIPE JOINT MATERIAL, CAST IRON
*Leadite Co., The, Philadelphia, Pa.
*United Lead Co., New York.
Hydrotite Co., Boston, Mass.

PLOWS, CONTRACTORS
*Burch Plow Works Co., Crestline, O.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Steel Scraper Co., Sidney, O.
Bucyrus Co., South Milwaukee, Wis.
Case Threshing Machine Co., J. I., Racine Wis.
Deere & Co., Moline, Ill.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
International Harvester Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Moline Plow Co., Moline, Ill.
Oliver Chilled Plow Works, South Bend, Ind.
Sidney Steel Scraper Co., Sidney, O.
Western Wheeled Scraper Co., Aurora, Ill.
Wiard Plow Co., Batavia, N. Y.

PLUMBING SUPPLIES
*Clow & Sons, J. B., Chicago, Ill.
*Imperial Brass Mfg. Co., Chicago, Ill.
*Mueller Mfg. Co., H., Decatur, Ill.
*Rundle Spence Mfg. Co., Milwaukee, Wis.
Glauber Brass Mfg. Co., Cleveland, O.
United Brass Mfg. Co., Cleveland, O.
Walworth Mfg. Co., Boston, Mass.

POLES, FLAG.
*Electric Railway Equipment Co., Cincinnati, O.

POLES, STEEL STRUCTURAL
*Electric Railway Equipment Co., Cincinnati, O.
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Manistee Iron Works, Manistee, Mich.
Morris Machine Works, Baldwinsville, N. Y.

PORTABLE BUILDINGS
*Truscon Steel Co., Youngstown, O.
Pruden Co., C. D., Baltimore, Md.

PORTABLE STEEL DERRICKS. **(See Derricks, Steel Portable.)**

PORTLAND CEMENT. **(See Cement.)**

POWDER. **(See Explosives.)**

PUMPS, AIR LIFT
*Indiana Air Pump Co., Indianapolis, Ind.
*Worthington Pump & Mchy. Corp., New York.
Advance Pump & Compr. Co., Battle Creek, Mich.
American Steam Pump Co., Battle Creek, Mich.
Cameron Steam Pump Works, A. S., New York.
Emerson Pump & Valve Co., Alexander, Va.
Ingersoll-Rand Co., New York.
McGowan & Co., J. H., Cincinnati, O.
Sullivan Machinery Co., Chicago, Ill.
Union Steam Pump Co., Battle Creek, Mich.

PUMPS, BOILER FEED
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., E. Trenton, N. J.
*Deming Co., Salem, O.
*Fairbanks, Morse & Co., Chicago, Ill.
*Indiana Air Pump Co., Indianapolis, Ind.
*Lea-Courtenay Co., Newark, N. J.
*Yeomans Bros. Co., Chicago, Ill.
Advance Pump & Compr. Co., Battle Creek, Mich.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
Gardner Governor Co., Quincy, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Scranton Pump Co., Scranton, Pa.
Vogt Bros. Mfg. Co., Louisville, Ky.
Warren Steam Pump Co., Warren, Mass.
Weinman Pump Mfg. Co., Columbus, O.

PUMPS, CENTRIFUGAL. **(See Centrifugal Pumps.)**

PUMPS, CONTRACTORS'
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Deming Co., Salem, O.
*Lea-Courtenay Co., Newark, N. J.
*Waldo Bros. & Bond Co., Boston, Mass.
American Well Works, Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
Emerson Pump & Valve Co., Alexandria, Va.
Erie Pump & Engine Works, Medina, N. Y.
McGowan Co., J. H., Cincinnati, O.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Pulsometer Steam Pump Co., New York.
Schramm & Son, Inc., Chris. D., Philadelphia, Pa.
Smith Co., T. L., Chicago, Ill.
Standard Scale & Supply Co., Pittsburgh, Pa.
Universal Motor Co., Oshkosh, Wis.
Van Nouhuys Machine Wks., Albany, N. Y.
Waterloo Const. Mach. Co., Waterlooo, Ia.

Where to Purchase

PUMPS, DEEP WELL

*Clark Co., H. W., Mattoon, Ill.
*Cook, A. D., Lawrenceburg, Ind.
*Deming Co., Salem, O.
*Fairbanks, Morse & Co., Chicago, Ill.
*Indiana Air Pump Co., Chicago, Ill.
*Nordberg Mfg. Co., Milwaukee, Wis.
*United Iron Works, Kansas City, Mo.
Aldrich Pump Co., Allentown, Pa.
American Well Works, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Keystone Driller Co., Beaver Falls, Pa.
Layne & Bowler Co., Memphis, Tenn.
Midwest Engine Co., Indianapolis, Ind.
Weber Subterranean Pump Co., New York.

PUMPS, DREDGING

*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Wood & Co., R. D., Philadelphia, Pa.
*Worthington Pump & Mchy. Corp., New York.
Aldrich Pump Co., Allentown, Pa.
American Well Works, Aurora, Ill.
Buffalo Steam Pump Co., Buffalo, N. Y.
Domestic Eng. & Pump Co., Shippensburg, Pa
Erie Pump & Eng. Co., Medina, N. Y.
Marion Steam Shovel Co., Marion, O.
Morris Machine Works, Baldwinsville, N. Y.
Rumsey Pump Co., Ltd., Seneca Falls, N. Y.

PUMPS, GASOLINE AND OIL

*Bowser & Co., S. F., Fort Wayne, Ind.
*Kinney Mfg. Co., Boston, Mass.

PUMPS, POWER

*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., Trenton, N. J.
*Deming Co., Salem, O.
*Fairbanks, Morse & Co., Chicago, Ill.
*Indiana Air Pump Co., Indianapolis, Ind.
*Kinney Mfg. Co., Boston, Mass.
*Koehring Machine Co., Milwaukee, Wis.
*Lea-Courtenay Co., Newark, N. J.
*Nordberg Mfg. Co., Milwaukee, Wis.
*United Lead Company, New York.
*Worthington Pump & Machy. Corp., New York.
*Yeomans Bros., Chicago, Ill.
Alamo Iron Works, San Antonio, Tex.
American Steam Pump Co., Battle Creek, Mich.
American Well Works, Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
Domestic Eng. & Pump Co., Shippensburg, Pa.
Gardner Governor Co., Quincy, Ill.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Ingersoll-Rand Co., New York.
Lawrence Machine Co., Lawrence, Mass.
McGowan Co., J. H., Cincinnati, O.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville N. Y
Weinman Pump Mfg. Co., Columbus, O.

RAIL AND RAIL JOINTS

*Zelnicker Supply Co., W., St. Louis, Mo.
Bethlehem Steel Co., Bethlehem, Pa.
Cambria Steel Co., Philadelphia, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Easton Car & Constn. Co., New York.
Hirsch Rolling Mill Co. St. Louis, Mo.
Lackawanna Steel Co., Buffalo, N. Y.

RAIL-ROAD DITCHERS

*Austin-Western Road Mchy. Co., Chicago, Ill.
American Hoist & Derrick Co., St. Paul, Minn
Austin Machinery Corp'n., Chicago, Ill.
Ball Engine Co., Erie, Pa.
Buckeye Traction Ditcher Co., Findlay, O.
Byers Machine Co., J. F., Ravenna, O.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.
Thew Automatic Shovel Co., Lorain, O.

RECORDERS, WATER STAGE

*Builders Iron Fdry., Providence, R. I.
Gurley, W. & L. E., Troy, N. Y.

REINFORCING CONCRETE. (See Concrete Reinforcements.)

RIVETERS, PNEUMATIC

Alliance Machine Co., Alliance, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Hanna Eng. Works, Chicago, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Watson-Stillman Co., New York.

RIVETS, BRIDGE AND STRUCTURAL. (See Bolts, Nuts, Etc.)

ROAD OILERS

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Autocar Co., Ardmore, Pa.
*Good Roads Machinery Co., Philadelphia, Pa.
*Kinney Mfg. Co., Boston, Mass.
*Selden Truck Corpn., Rochester, N. Y.
*Service Motor Truck Co., Wabash, Ind.
*Universal Road Mchy. Co., Kingston, N. Y.
*White Co., Cleveland, O.
Etnyre & Co., E. D., Oregon, Ill.
Four Wheel Drive Auto Co., Clintonville, Wis.
Huber Mfg. Co., Marion, O.

ROAD ROLLERS

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co., Springfield, O.
*Erie Machine Shops, Erie, Pa.
*Good Roads Machinery Co., Philadelphia, Pa.
*Universal Road Mchy. Co., Kingston, N. Y.
Case Threshing Machine Co., J. I., Racine, Wis.

ROAD AND STREET MACHINERY

*Acme Road Machinery Co., Frankfort, N. Y.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co, Springfield, O.
*Connery & Co., Inc., Philadelphia, Pa.
*Erie Machine Shops, Erie, Pa.
*Good Roads Machinery Co., Philadelphia, Pa.
*Haiss Mfg. Co., Geo., New York.
*Holt Mfg. Co., Peoria, Ill.
*Kinney Mfg. Co., Boston, Mass.
*Koehring Machine Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Union Iron Prod. Co., East Chicago, Ind.
*United Iron Works, Kansas City, Mo.
*Universal Road Mchy. Co., Kingston, N. Y.
*Zieg Mfg. Co., F. B., Fredericktown, O.
Atlas Engineering Co., Milwaukee, Wis.
Austin Machinery Corp'n., Chicago, Ill.
Koppel Ind. Car & Equipment Co., Koppel, Pa.
Lakewood Engineering Co., Cleveland, O.

ROCK CRUSHERS

*Acme Road Machinery Co., Frankfort, N. Y.
*Allis-Chalmers Mfg. Co. Milwaukee, Wis.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Good Roads Machinery Co., Philadelphia, Pa.
*Universal Road Machinery Co., Kingston, N. Y.
*Worthington Pump & Mchy. Corp., New York.
Chalmers & Williams, Inc., Chicago Heights, Ill.
Fuller Lehigh Co., Fullerton, Pa.
Galion Iron Works Mfg. Co., Galion, O.
Jeffrey Mfg. Co., Columbus, O.
Link Belt Co., Philadelphia, Pa.
McLanahan-Stone Mchy. Co., Hollidaysburg Pa.
Raymond Bros. Impact Pulv. Co., Chicago, Ill.
Smith Co., T. L., Chicago, Ill.
Smith Eng. Works, Milwaukee, Wis.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Williams Patent Crusher & Pulv. Co., Chicago, Ill.

Where to Purchase

ROOFING, ASPHALT, COMPOSITION, ETC.
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Barrett Co., New York.
*Carey Mfg. Co., Philip, Cincinnati, O.
*Standard Oil Co. of Indiana, Chicago, Ill.
*Texas Co., New York.
American Cement Tile Mfg. Co., Pittsburgh, Pa.
Atlantic Refining Co., Philadelphia, Pa.
Bird & Son, E. Walpole, Mass.
Edwards Mfg. Co., Cincinnati, O.
Flintkote Co., Boston, Mass.
Johns-Manville Co., H. W., New York.
National Roofing Co., Tonawanda, N. Y.
Sonneborn & Sons, Inc., L., New York.
Standard Paint Co., New York.

ROOFING, METAL
*Truscon Steel Co., Youngstown, O.
American Rolling Mill Co., Canton, O.
Berger Mfg. Co., Canton, O.
General Fireproofing Co., Youngstown, O.
National Metal Roofing Co., Jersey City, N. J.
Stark Rolling Mill Co., Canton, O.

ROOFING KETTLES. (See Kettles)

ROPE, MANILA
American Mfg. Co., Brooklyn, New York.
Broderick & Bascom Rope Co., St. Louis, Mo.
Carpenter & Co., Geo. B., Chicago, Ill.
Columbian Rope Co., Auburn, N. Y.
Peoria Cordage Co., Peoria, Ill.
Plymouth Cordage Co., N. Plymouth, Mass.
Upson-Walton Co., Cleveland, O.
Waterbury Co., New York.

ROPE, WIRE, HOISTING, HAULAGE
*American Steel & Wire Co., Chicago, Ill.
Broderick & Bascom Rope Co., St. Louis, Mo.
Macomber & Whyte, Kenosha, Wis.
Roebling's Sons Co., J. A., Trenton, N. J.
Upson-Walton Co., Cleveland, O.
Waterbury Co., New York.
Wickwire-Spencer Steel Corp., Worcester, Mass.

RULES, FOLDING
*Kolesch & Co., N. Y. C.
Lufkin Rule Co., Saginaw, Mich.

SASH, ROLLED STEEL
International Steel & Iron Co., Evansville, Ind.
Lupton's Sons Co., David, Philadelphia, Pa.

SAW RIGS, PORTABLE
C. H. & E. Mfg. Co., Milwaukee Wis.
Knickerbocker Co., Jackson, Mich.
Standard Scale & Supply Co., Pittsburgh, Pa.

SCARIFIERS
*Acme Road Machy. Co., Frankfort, N. Y.
*Austin Western Road Mchy. Co., Chicago, Ill.
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co., Springfield, O.
*Good Roads Machinery Co., Philadelphia, Pa.
*Lyle Cul. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Mchy. Co., Kingston, N. Y.
Galion Iron Works & Mfg. Co., Galion, O.
Huber Mfg. Co., Marion, O.

SCRAPERS, DRAG
Smith Co., T. L., Chicago, Ill.

SCRAPERS, ROAD
*Acme Road Machy. Co., Frankfort, N. Y.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, O.
*Good Roads Machinery Co., Philadelphia, Pa.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Co., Minneapolis, Minn.
*Zieg Mfg. Co., F. B., Fredericktown, O.
Case Threshing Machine Co., J. I., Racine, Wis.
East Iron & Machine Co., Lima, O.
Galion Iron Works & Mfg. Co., Galion, O.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Sidney Steel Scraper Co., Sidney, O.

SCRAPERS, SELF-LOADING
*Baker Manufacturing Co., Springfield, Ill.

SCREENS, SAND, GRAVEL AND COAL
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Haiss Mfg. Co., Geo., New York.
*Littleford Bros., Cincinnati, O.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Bartlett & Snow Co., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Philadelphia, Pa.
New Jersey Wire Cloth Co., Trenton, N. J.
Robins Conv. Belt Co., N. Y. C.
Sackett Screen & Chute Co., H. B., Chicago, Ill.
Webster Mfg. Co., Tiffin, O.
Wickwire-Spencer Steel Corp., Worcester, Mass.

SCREENS, SEWER
Chain Belt Co., Milwaukee, Wis.

SCREWS
American Screw Co., Providence, R. I.
Clark Bros. Bolt Co., Milldale, Conn.
St. Louis Screw Co., St. Louis, Mo.

SECOND-HAND MACHINERY
*Zelnicker Supply Co., Walter A., St. Louis, Mo.
Wickes Mach. Co., Jersey City, N. J.

SEWAGE PUMPS AND EJECTORS
*Otterson Auto Eductor Co., Springfield, O.
*Pacific Flush Tank Co., Chicago, Ill.
*Yeoman Bros. Co., Chicago, Ill.
Erie Pump & Eng. Works, Medina, N. Y.
Walworth Mfg. Co., Boston, Mass.

SEWER BLOCKS, SEGMENT
*McNutt Meter Box Co., Brazil, Ind.
American Sewer Pipe Co., Akron, O.
Blackmer & Post Pipe Co., St. Louis, Mo.
Chicago Reinforced Conc. Pipe Co., Chicago, Ill.
Denver Sewer Pipe & Clay Co., Denver, Col.

SEWER CLEANING APPARATUS
*Champion Corporation, Hammond, Ind.
*Healey, P. J., New York.
*Thompson-Fleming Co., Inc., Buffalo, N. Y.
*Turbine Sewer Machine Co., Milwaukee, Wis.

SEWER PIPE AND DRAIN TILE
*Dee Co., Wm. E., Chicago, Ill.
American Sewer Pipe Co., Akron, O.
Blackmer & Post Pipe Co., St. Louis, Mo.
Denver Sewer Pipe & Clay Co., Denver, Col.
National Fireproofing Co., Pittsburgh, Pa.
Robinson Clay Product Co., Akron, O.

SEWER RODS
*Bissell Co., F., Toledo, O.
*Champion Corpn., Hammond, Ind.
*Turbine Sewer Machine Co., Milwaukee, Wis.

SHOVELS, ELECTRIC
Bucyrus Co., South Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.
Thew Shovel Co., Lorain, O.

SHOVELS, GASOLINE
American Steel Dredge Co., Fort Wayne, Ind.
Austin Mach. Corp., Chicago, Ill.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Thew Shovel Co., Lorain, O.

SHOVELS, HAND
American Shovel & Stamping Co., Lorain, O.
Ames & Sons Corp., Oliver R., N. Easton, Mass.
Chisholm's Steel Shovel Works, Cleveland, O.
Conneaut Shovel Co., Conneaut, O.
Hubbard & Co., Pittsburgh, Pa.
Indiana Shovel Co., New Castle, Ind.
Pittsburgh Shovel Co., Pittsburgh, Pa.
Wyoming Shovel Works, Wyoming, Pa.

SHOVELS, STEAM
American Steel Dredge Co., Fort Wayne, Ind.
Austin Mach. Corp., Chicago, Ill.
Ball Engine Co., Erie, Pa.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., J. F., Ravenna, O.
Fairbanks Steam Shovel Co., Marion, O.
Industrial Works, Bay City, Mich.
Keystone Driller Co., Beaver Falls, Pa.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.
Smith Co., T. L., Chicago, Ill.
Thew Shovel Co., Lorain, O.

Where to Purchase

SIGNS, STREET AND ROAD
*Baltimore Enamel & Novelty Co., Baltimore, Md.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Stewart Iron Works, Cincinnati, O.
*Thompson-Fleming Co., Inc., Buffalo, N. Y.
*Union Iron Products Co., East Chicago, Ind.
Flour City Orn. Iron Co., Minneapolis, Minn.
Lebanon Machine Co., Lebanon, N. H.
N. Y. Enameled Steel Sign Co., New York.

SLEEVES, TAPPING AND VALVE
*Flower Valve Mfg. Co., Detroit, Mich.
*Kennedy Valve Co., Elmira, N. Y.
*Mueller Mfg. Co., Decatur, Ill.
*Rensselaer Valve Co., Troy, N. Y.
*Smith Mfg. Co., A. P., East Orange, N. J.
Water Works Equipment Co., New York.

SLUICE GATES. (See Gates, Sluice.)

SNOW CLEANING MACHINERY
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Good Roads Machinery Co., Philadelphia, Pa.
*Holt Mfg. Co., Peoria, Ill.
*Zieg Mfg. Co., Fredericktown, O.
Owensboro Ditcher & Grader Co., Owensboro, Ky.

SPREADERS, STONE
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Burch Plow Works Co., Crestline, O.

STACKS, STEEL
*Chicago Bridge & Iron Works, Chicago, Ill.
*Connery & Co., Inc., Philadelphia, Pa.
*Littleford Bros., Cincinnati, O.
Blaw-Knox Co., Pittsburgh, Pa.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Petroleum Iron Works Co., Sharon, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STANDPIPE, TANKS AND TOWERS
*Chicago Bridge & Iron Works, Chicago, Ill.
*Connery & Co., Philadelphia, Pa.
*Fairbanks, Morse & Co., Chicago, Ill.
*Pacific Tank & Pipe Co., San Francisco, Cal.
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
*United Iron Works Co., Kansas City, Mo.
Blaw-Knox Co., Pittsburgh, Pa.
Caldwell Co., W. E., Louisville, Ky.
Chattanooga Blr. & Tank Co., Chattanooga, Tenn.
Eagle Tank Co., Chicago, Ill.
Petroleum Iron Works Co., Sharon, Pa.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STEAM TURBINES
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*DeLaval Steam Turbine Co., Trenton, N. J.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

STEEL PLATE CONSTRUCTION
*Chicago Bridge & Iron Works, Chicago, Ill.
*Heltzel Steel Form & Iron Co., Warren, O.
*Littleford Bros., Cincinnati, O.
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
Bethlehem Steel Bridge Co., Bethlehem, Pa.
Birmingham Steel Corp., Birmingham, Ala.
Blaw-Knox Co., Pittsburgh, Pa.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
McClintic-Marshall Co., Pittsburgh, Pa.
Pennsylvania Bridge Co., Beaver Falls, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Toledo Bridge & Crane Co., Toledo, O.
Union Iron Works, Hoboken, N. J.
Vulcan Iron Works, Jersey City, N. J.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STOKERS, MECHANICAL
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Babcock & Wilcox Co., N. Y. C.

STREET LAMPS
*Cutler Works, Geo., South Bend, Ind.
*Electric Railway Equipment Co., Cincinnati, O.
*General Elec. Co., Schenectady, N. Y.
*King Mfg. Co., Chicago, Ill.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Union Metal Mfg Co., Canton, O.

STREET AND ROAD SIGNS. (See Signs, Street and Road.)

STREET CLEANERS AND FLUSHERS
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Autocar Co., Ardmore, Pa.
*Elgin Sales Corp'n., New York.
*Federal Motor Truck Co., Detroit, Mich.
*Good Roads Machinery Co., Philadelphia, Pa.
*Municipal Supply Co., South Bend, Ind.
*Rochester Can Co., Rochester, N. Y.
*Service Motor Truck Co., Wabash, Ind.
*Thompson-Fleming Co., Inc., Buffalo, N. Y.
*Tiffin Wagon Co., Tiffin, O.
*Universal Road Mchy. Co., Kingston, N. Y.
*White Company, Cleveland, O.
Etnyre & Co., E. D., Oregon, Ill.
Four Wheel Drive Auto Co., Clintonville, Wis.

STRUCTURAL STEEL AND IRON. (See Bridges and Buildings)

STUMP PULLERS
Bennett & Co., H. L., Westerville, O.
Carpenter & Co., Geo. B., Chicago, Ill.
Clyde Iron Works, Duluth, Minn.
Lewis & Valentine, Roslyn, L. I.
Thomas Elevator Co., Chicago, Ill.

SURVEYORS' INSTRUMENTS. (See Instruments, Surveying.)

TABLES AND BOARDS, DRAWING. (See Drawing Materials.)

TAMPING MACHINES
*Pawling & Harnishfeger Co., Milwaukee, Wis.
Waterloo Const. Mach. Co., Waterlooo, Ia.

TANKS, AIR COMPRESSOR
*Chicago Bridge & Iron Works, Chicago, Ill.
*Connery & Co., Inc., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Indiana Air Pump Co., Indianapolis, Ind.
*Littleford Bros., Cincinnati, O.
*Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
*Worthington Pump & Machy. Corp., New York.
Abendroth & Root Mfg. Co., New York.
National Tube Co., Pittsburgh, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.
Westinghouse Tract. Brake Co., Wilmerding, Pa.

TANKS, OIL. (See Oil Tanks.)

TANKS, STEEL
*Chicago Bridge & Iron Works, Chicago, Ill.
*Columbian Steel Tank Co., Kansas City, Mo.
*Connery & Co., Inc., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
*Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Hardesty Mfg. Co., R., Denver, Col.
Petroleum Iron Works Co., Sharon, Pa.
Scaife & Sons, Wm. B., Oakmont, Pa.

TANKS, WOOD
Pacific Tank & Pipe Co., San Francisco, Cal.
Eagle Tank Co., Chicago, Ill.
Hauser-Stander Tank Co., Cincinnati, O.
Scaife & Sons, Wm. B., Oakmont, Pa.
Stearns Lumber Co., A. T., Boston, Mass.

TANK WAGONS
*Acme Road Mach. Co., Frankfort, N. Y.

TAPES, STEEL AND METALLIC
*Kolesch & Co., New York.
Dietzgen Co., Eugene, New York.
Gurley, W. & L. E., Troy, N. Y.
Hamilton Mfg. Co., Two Rivers, Wis.
Keuffel & Esser Co., Hoboken, N. J.
Lufkin Rule Co., Saginaw, Mich.

TAR
*Barrett Co., New York.

TAR KETTLES. (See Kettles)

TIES, STEEL
Carnegie Steel Co., Pittsburgh, Pa.

Where to Purchase

TIRES, RUBBER
*Dayton Rubber Mfg. Co., Dayton, O.
*Firestone Tire & Rubber Co., Akron, O.
*Goodyear Tire & Rubber Co., Akron, O.
*Kelly Springfield Tire Co., New York.
*U. S. Tire Co., New York.
Goodrich Rubber Co., B. F., Akron, O.

TOOL HOUSES, PORTABLE STEEL
*Littleford Bros., Cincinnati, O.

TOWERS (See Standpipe Tanks and Towers)

TRACKS, INDUSTRIAL AND PORTABLE
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constn. Co., New York.
Koppel Ind. Car & Equipment Co., Koppel, Pa.
Lakewood Engineering Co., Ceveland, O.
Light Railway Equipment Co., Philadelphia, Pa.

TRACTORS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*American-La France Fire Eng. Co., Elmira, N. Y.
*Fairbanks, Morse & Co., Chicago, Ill.
*Holt Mfg. Co., Peoria, Ill.
*Selden Truck Corpn., Rochester, N. Y.
*Service Motor Truck Co., Wabash, Ind.
*Watson Products Corp., Canastota, N. Y.
*White Company, The, Cleveland, O.
Advance-Rumely Thresher Co., Laporte, Ind.
Case Threshing Machine Co., J. I., Racine, Wis.
Clark Tructractor Co., Chicago, Ill.
Cleveland Tractor Co., Cleveland, O.
Dayton-Dowd Co., Quincy, Ill.
Four Wheel Drive Auto Co., Clintonville, Wis.
Huber Mfg. Co., Marion, O.
J. T. Tractor Co., Cleveland, O.
Oliver Tractor Co., Knoxville, Tenn.

TRAILERS FOR MOTOR TRUCKS
Eagle Wagon Works, Auburn, N. Y.
Highway Trailer Co., Edgerton, Wis.
Troy Wagon Works, Troy, O.
Watson Products Corp'n., Canastota, N. Y.

TRAILERS, INDUSTRIAL
Chase Fdry. & Supply Co., Columbus, O.
Electric Wheel Co., Quincy, Ill.
Lakewood Engineering Co., Cleveland, O.
Lee Loader & Body Co., Chicago, Ill.

TRAMWAYS, AERIAL WIRE ROPE
Broderick & Bascom Rope Co., St. Louis, Mo.

TRANSFORMERS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*General Electric Co., Schenectady, N. Y.
*Kuhlman Electric Co., Bay City, Mich.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

TRANSITS AND LEVELS
*Kolesch & Co., New York.
Ainsworth & Sons, Wm., Denver, Col.
Berger & Sons Co., C. L., Boston, Mass.
Buff & Buff Mfg. Co., Boston, Mass.
Eugene Dietzgen Co., New York.
Gurley, W. & L. E., Troy, N. Y.
Keuffel & Esser, Hoboken, N. J.
Lietz Co., A., San Francisco, Cal.

TRANSMISSION MACHINERY, POWER
*General Electric Co., Schenectady, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link Belt Co., Chicago, Ill.
Webster Mfg. Co., Tiffin, O.
Weller Mfg. Co., Chicago, Ill.

TREADS, SAFETY
American Mason Safety Tread Co., Boston, Mass.
Concrete Steel Co., New York.
Irving Iron Works, Long Island City.

TRUCTRACTORS
Clark Tructractor Co., Chicago, Ill.

TURBINES
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., Trenton, N. J.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Midwest Eng. Co., Indianapolis, Ind.

VALVES, GATE AND INDICATOR POSTS
*Crane Company, Chicago, Ill.
*Eddy Valve Co., Waterford, N. Y.
*Flower Valve Mfg. Co., Detroit, Mich.
*Kennedy Valve Mfg Co., Elmira, N. Y.
*Ludlow Valve Co., Troy, N. Y.
*Norwood Engineering Co., Florence, Mass.
*Pratt & Cady Co., Inc., Hartford, Conn.
*Rensselaer Valve Co., Troy, N. Y.
*Smith Mfg. Co., A. P., East Orange, N. J.
*Wood & Co., R. D., Philadelphia, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Darling Valve Mfg. Co., Williamsport, Pa.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Lunkenheimer Co., Cincinnati, O.

VALVE BOXES AND HOUSINGS
*Central Foundry Co., New York.
*Clark Co., H. W., Mattoon, Ill.
*Clow & Sons, J. B., Chicago, Ill.
*Columbian Iron Works, Chattanooga, Tenn.
*Eddy Valve Co., Waterford, N. Y.
*Flower Valve Mfg. Co., Detroit, Mich.
*Kennedy Valve Mfg. Co., Elmira, N. Y.
*Ludlow Valve Co., Troy, N. Y.
*Mueller Mfg. Co., H., Decatur, Ill.
*Pratt & Cady Co., Inc., Hartford, Conn.
*Rensselaer Valve Co., Troy, N. Y.
*S. E. T. Valve & Hydrant Co., New York.
*Smith Mfg. Co., A. P., East Orange, N. J.
*U. S. C. Ir. Pipe & Fdry. Co., Burlington, N. J.
*Wood & Co., R. D., Philadelphia, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Darling Valve Mfg. Co., Williamsport, Pa.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.

VENTILATORS
American Blower Co., Detroit, Mich.
Edwards Mfg. Co., Cincinnati, O.
Milwaukee Corrugating Co., Milwaukee, Wis.

WAGONS
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Tiffin Wagon Co., Tiffin, O.
*White Company, The, Cleveland, O.
Eagle Wagon Works, Auburn, N. Y.
Troy Wagon Works, Troy, O.
Watson Products Corp'n., Canastota, N. Y.
Western Wheeled Scraper Co., Aurora, Ill.

WAGON LOADERS. (See Loaders, Gravel and Wagon)

WALL TIES
*Niagara Falls Met. Stamp. Wks., Niagara Falls.
Berger Mfg. Co., Canton, O.
Milwaukee Corrugating Co., Milwaukee, Wis.

WATER MAIN CLEANING
*National Water Main Cleaning Co., New York.

WATER MAIN TAPPING MACHINES
*Mueller Mfg. Co., H., Decatur, Ill.
*Smith Mfg. Co., A. P., E. Orange, N. J.

WATER METERS. (See Meters, Water and Oil.)

WATERPROOFING COMPOUNDS AND MATERIAL
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Barrett Company, New York.
*Carey Company, Philip, Cincinnati, O.
*Standard Oil Co. of Indiana, Chicago, Ill.
*Texas Company, New York.
*Truscon Steel Co., Youngstown, O.
Anti-Hydro Waterproofing Co., New York.
Atlantic Refining Co., Philadelphia, Pa.
Carbolineum Wood Preserving Co., New York.
General Fireproofing Co., Youngstown, O.
Minwax Co., The, New York.
Sonneborn Sons, Inc., New York.
Standard Paint Co., New York.
Toch Brothers, New York.

** Indicates that the manufacturer carries an advertisement.* *See index facing inside back cover.*

Where to Purchase

WATER PURIFICATION
***Clow & Sons, J. B., Chicago, Ill.**
***Electro Bleaching Gas Co., New York.**
***Hooker Electrochemical Co., New York.**
***Mathieson Alkali Works, Inc., New York.**
***Norwood Eng. Co., Florence, Mass.**
***Penna. Salt Mfg. Co., Philadelphia, Pa.**
***Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.**
***R. U. V. Company, New York.**
***Wallace & Tiernan Co., Inc., New York.**
Permutit Co., New York.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.

WATER REGULATORS
***Mueller Mfg. Co., Decatur, Ill.**
***Pacific Flush Tank Co., New York.**
***Union Water Meter Co., Worcester, Mass.**

WATER SOFTENERS
***N. Y. Continental Jewell Filtr. Co., Nutley, N. J.**
***Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.**
American Water Softener Co., Philadelphia, Pa.
Borromite Co., Chicago, Ill.
International Filter Co., Chicago, Ill.
Mathieson Alkali Works, New York.
Permutit Company, New York.
Refinite Co., Omaha, Neb.
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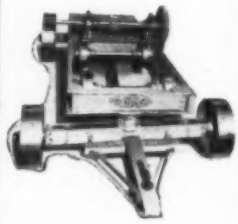

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EDITORIAL

Contractors' & Engineers'
Purchasing Guide

New York August-September, 1920

Dynamite in Road Building

A Description of Methods of Using This Time-, Labor- and Money-Saver

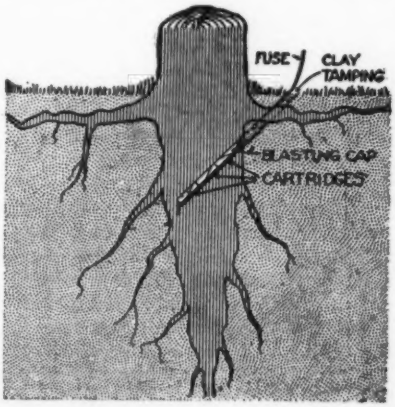
THE use of dynamite in road building has long been recognized as a necessity. In the case of new or relocated roads its value for clearing away trees and stumps is unquestioned. Its use in combination with a mechanical stump puller, teams or tractors is a common practice with road contractors. The stumps, both large and small, are shattered by moderate-sized charges, after which the puller, team or tractor is attached and the stump drawn off the right of way. The size of the charges may be graduated to meet the requirements of the combined use of dynamite and the other agencies mentioned. It requires a smaller amount of explosive to loosen a stump than to blast it entirely free of the earth.

Blasting Stumps

Stumps offer the same impediment to road building as boulders, and their removal is just as important and necessary. Many thorough tests covering a long period of time prove that the most satisfactory means of ridding a right of way of stumps is the rational use of dynamite or powder. This applies equally well whether it be in swampy places or in hard-pan.

Trees similar to the pine, when not interfered with by hard-pan, usually send down heavy tap-roots. For blasting these the best method is to start a hole in the ground some distance away from the stump, as shown in the illustration, so that it will reach the center of the tap-foot about 15 to 18 inches below the surface of the ground, or deeper. Then, using a wood auger, bore a 1½-inch or 2-inch hole about three-fourths of the way through the root and load it with dynamite of 30 to 40 per cent strength, taking due precaution in loading and tamping. Split all cartridges except the primer, and pack as much of the charge as is possible into the hole in the wood and place the remainder as close to the wood as possible.

As the loading of such stumps will vary considerably on account of differences in the toughness of the roots, their state of preservation and the resistance offered by the soil in which they grow, no set rules can be laid down for the amount of dynamite needed for any given size of stump. Fresh green stumps are much harder to blast than similar ones that have been cut for a year or more. The only way to gauge the load is by experience. Try a few, loading the



A CHARGE PROPERLY PLACED FOR BLASTING STUMPS HAVING TAP ROOTS

THE RESULT OF BLASTING A STUMP WITH TAP ROOTS

first one heavier than you feel is necessary, and later cut down the amount of dynamite used until there is no overloading. It is better to overload a stump slightly than underload it, for when a stump is once shattered by a charge not large enough to lift it out of the ground, portions of the stump and root are left clinging in the hole and are removed with difficulty.

The novice should begin on the small stumps and work up to the large ones. Take a stump about 12 inches in diameter at the surface of the ground and start the hole back about 15 inches, boring to within 3 inches of the far side of the root. Load this with two cartridges, and carefully note the results. If the loading is too light, try more dynamite in the next one; if too heavy, try less.

Some classes of forest trees are supported by stumps having no tap-root but many heavy lateral roots. These can also be blasted easily. For such a stump, the method of loading is to punch a hole under the stump at an angle with the surface of the ground to a depth of about 18 to 24 inches. This hole should be so placed that the major portion of the dynamite is directly under the heaviest part of the stump, and should ordinarily extend decidedly more than half-way under the body of the stump in order to avoid the danger of loading too near the side and lifting out only a part of the stump and its roots. The best explosive for this work will be determined by conditions, but usually a 25 per cent dynamite will be found satisfactory.

When stumps are too large to be successfully blasted by a single charge, the method of loading should be modified as follows: A hole is put down under the stump and loaded as described for small fibrous-rooted stumps, the only difference being that an electric blasting cap is used instead of the cap and fuse. Additional holes are punched under the large roots and loaded with small charges, each primed with an electric blasting cap. The wires are then connected as shown in the illustration, and the shot is fired with a blasting machine. The explosive used should be of 25 per cent dynamite.

This method of loading is also recommended for blasting second-growth stumps and those having hollow centers, for with such stumps a single charge is quite likely to split the stump without lifting it.

In the Pacific Coast states, fir, pine and cedar trees grow to enormous size. The roots usually spread out near the surface, but do not grow as deep into the ground as might be expected. Tap-roots are extremely rare. When blasting stumps of these trees, the object is not to split them but to bring them out entirely with all the roots possible. If the charge of the explosive is so gauged and located as to split the stump, it usually fails to bring out all the roots. It is better to blast it out first and then split it by means of a small charge of dynamite loaded into an auger hole in the thickest part of the stump; dynamite of 25 per cent strength is recommended for this work.

On account of the variations in the soil and in the roots of these stumps, no absolutely definite rule can be made for the amount of dynamite required to blast a stump of a given size, but a large number of tests have demonstrated that the following figures can be used as a guide. For large stumps it is advisable to use from one-

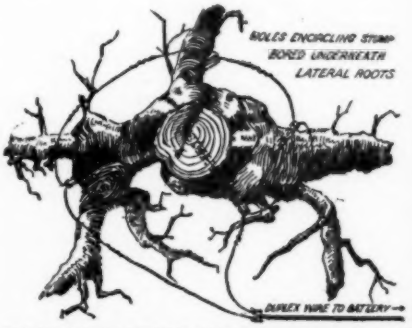


DIAGRAM SHOWING CIRCUIT, LOCATION OF HOLES AND PROPER WIRE CONNECTIONS FOR REMOVING STUMPS HAVING LARGE LATERAL ROOTS

half to one 1¼ by 8-inch cartridge for each inch in diameter. The charge of explosive is best placed with 16 to 24 inches of earth between the charge and the bottom of the stump. The result is that the force of the explosion radiates to all sides, lifting the stump clear of the ground and bringing with it the greatest length of roots. If the charge is placed too close to the stump, the effect is to split it, leaving the roots to be dug out at extra expense. When a large charge is required, the most economical way to make a hole is to punch or bore a small hole under the stump and load this with a half cartridge of the dynamite and shoot it without tamping. If this does not make a hole large enough to receive the entire charge, spring the hole larger by using a full stick of dynamite. Do not load this second charge into the hole until the ground has had sufficient time to cool, and do not under any circumstances load the charge for blasting a stump into a chambered hole until a considerable time has elapsed, as there is great danger that the hot soil may cause a premature explosion and perhaps injure the blaster.

A DRAINAGE DITCH MADE COMPLETELY BY BLASTING

Trees can be felled and their stumps and roots removed at one operation by loading under them as under stumps. If the trees are alive, the roots will be strong and require somewhat heavier loading than dead stumps would. If the body of the tree is valuable for saw timber, care should be taken not to overload, as there is danger of splitting the trunk and thereby reducing its value.

When stumps are small and numerous, they can be pulled by a team of horses hitched direct, or by a capstan puller, with ease and speed after they have been loosened with light charges of dynamite. The stumps thus pulled can be disposed of by hand directly without trouble.

The folly of pulling out stumps that are large and then spending as much money in getting rid of them and filling the holes as it costs to pull them will be plain to anyone. The contractor or engineer must remember the necessity of disposing of stumps after they are out of the ground. It is expensive and difficult to haul or burn whole stumps. Several hundred pounds of earth nearly always stick to the roots of big stumps taken out unbroken. When the amount of the clearing is large enough to justify the purchase of pulling equipment, it is undoubtedly in the interest of economy to use it in connection with dynamite. Pullers are not suitable for taking out occasional stumps, but only for clearing cut-over land where stumps stand close together. The machine should be brought on the job only after necessary blasting has been done.

Labor Economy

With the present high prices for labor, many engineers are more fully appreciating the fact that explosives will do some parts of their work far more quickly and more economically than other agencies. Machinery cannot be used advantageously on poorly drained and poorly cleared areas. Government reports show that one man with dynamite can do the work of six with picks and shovels in digging a ditch, and at less cost. A careful reading of the following section dealing with ditching will help you.

Providing Drainage Ditches

The oldest and best understood method of ditching is the hand method, where the earth is removed by shovels. Ordinarily this is difficult, as with the present demand for labor in all lines of work it is hard to get men to ditch. This difficulty should always be borne in mind in deciding upon the method you will employ for your ditching. The cost per cubic yard of earth excavated by hand is always high.

For the construction of large ditches 15 or more feet in width and of great length, the floating dredge is now used quite successfully and is excavating earth at less than half the cost of hand labor. Other means employed for ditching are traction diggers and combinations of plow, scraper and shovel work. The expense of such methods varies greatly under different conditions of soil and labor costs. Ditching in any one of these ways is retarded and the cost naturally increased if stumps, boulders or other obstructions are encountered in the ditch, or if the ground is marshy.

With few exceptions, ditches can be excavated by the proper use of dynamite for blowing out all of the earth, or a major part of it, and leaving the remainder in a loose, easily workable condition, so that it can be handled at a minimum cost by shovel or light horse scrapers.

There are two distinct methods of ditching, each having its advantages for certain kinds of work. These two methods are known as the propagated or transmitted blast, and the electric blast.

In wet ground or in a swamp where it is almost impossible to get labor to work, where the use of machinery is practically prohibited and where teams are used at a great disadvantage on account of the bad footing for draught animals, ditching is accomplished most satisfactorily by means of a transmitted blast. This type of ditch is also recommended in all wet or saturated soils where water will rise in the holes punched for the blast, unless the water is cold enough to freeze straight nitro-glycerine dynamite, in which case "low-freezing" dynamite is used in an electric blast. Ditching with the transmitted blast should not be attempted when the water in the bore hole is colder than 50° F.

A line of holes is punched with a punch bar or, if very resistant hard-pan is encountered, with a drive point, to about the desired bottom of the ditch. In some soils these holes should be to the grade of the ditch bottom, but in others, especially where the surface is hard and the lower soil soft and easily handled, the holes need not be so deep, as there is better execution with shallow holes and the labor cost is reduced. The holes are put down along the center line of the ditch and are spaced from 18 to 24 inches apart when only one cartridge is used in each hole. This spacing can be increased if heavier charges are used in each hole. Never attempt to load any considerable length of ditch without first making a few preliminary test shots of from 5 to 10 holes each, in order to determine the best depth of holes, the most economical spacing and the proper number of cartridges to load in each hole. A few tests of this kind will decrease the cost and enable the blaster to complete a better ditch than would otherwise be possible.

For a small ditch of no great depth a single cartridge of straight nitroglycerin dynamite of 50 or 60 per cent strength is loaded in the bottom of each hole. No tamping is required if the water rises a few inches over the cartridge. When all holes are thus loaded, a second cartridge, primed in the end, is placed over the cartridges already loaded in the center of the line, and when all persons are out of danger, the charge is detonated. The shock from this single primer cartridge detonates the adjoining charges, and these charges detonate those next in line, and so on, to both ends of the row of holes. The explosive wave passes through even a long line of holes faster than can be detected by the eye or the ear. The loaded soil is lifted into the air and spread over the adjoining field. With such loading of holes, 26 to 30 inches in depth, spaced 18 to 20 inches apart, ditches have been blasted up to 3½ feet in depth and 10 feet top width. Under the varying conditions of the soil the size will vary greatly. Larger or deeper ditches may be shot with a single line of deep holes, each loaded with several cartridges of 50 to 60 per cent dynamite.

Sometimes in light material that is very wet, charges smaller than one cartridge may be used, but in such work the loading must be carefully done to insure proper detonation. When cartridges are cut, the exposed

end of the dynamite should be covered with a small cap of mud to prevent exposing it to the water. Do not allow the charges to remain in the ground long before firing the shot, and use only 50 or 60 per cent straight nitroglycerin dynamite.

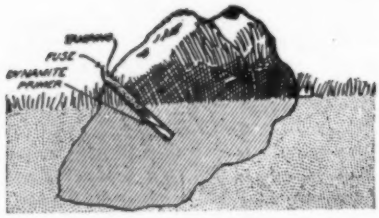
For larger ditches, 2, 3 and 4 lines of holes may be used. Such additional lines of holes are spaced from 3 to 5 feet from and parallel to the first line of holes. These are put down and loaded as has just been described. If a blasting machine is used for detonating, an electric blasting cap should be used in the center hole of each line. If caps and a fuse are used, put in one or more additional holes between the two lines and place the primer as shown in the diagram. Always add an extra cartridge to the primed hole.

When large stumps are found in the ditch line, put a few cartridges of dynamite under each, being sure that these are spaced not more than 18 inches apart and that one of them is near one of the regular holes. No extra loading need be used for small stumps. If boulders are encountered, these may be blasted at the same time as the ditch, or may be left and blasted later.

In dry or very hard ground where the resistance offered by the soil is so great that the explosive wave will not properly detonate holes some distance from the hole containing the primed charge, the electric method is used. In this work the holes may be spaced further apart. They are put down with a drive point or subsoil bar, and the dynamite is loaded at the bottom of the holes. A primer cartridge is used in each hole and should always be at the top of the charge if more than one cartridge is used. If there is no water in such holes they must be tamped tight. The number of holes that can be fired at one shot will depend on the size and strength of the blasting machine used. It is best to use one of the large sizes, as this will permit the shooting of long sections of ditch. What has been said above on transmitted blasts with regard to the variations in the depth and the spacing of the holes applies also to this class of ditching. For light loading in shallow holes the spacing can be materially increased. A few trial shots will give an idea of the depth and spacing required. If wide ditches are needed, two or more lines of holes should be used. The selection of dynamite for this work will vary with the soil and the kind of ditch needed. If narrow ditches in light soil are desired, 25 per cent dynamite should be used. For larger ditches or in hard soil 40 per cent is recommended.

If for any reason (such as cold weather conditions that would prohibit the use of straight nitroglycerin dynamites, or difficulty in securing the proper explosives) it

A FULL STREAM FLOWING THROUGH A BLASTED DITCH SOON AFTER THE EXPLOSION. NOTE THE UNIFORMITY OF THE DITCH AND CONSIDER THE SPEED WITH WHICH IT WAS DUG



A BLOCK HOLE PROPERLY PLACED TO BREAK A BOULDER

should be desirable to shoot a ditch in wet ground, the primers should be made waterproof by using soap, tallow or a cap of sticky mud over the end of the cartridge where the electric blasting cap is inserted. Such shots should be fired as soon as possible after loading, as the extra dynamites are likely to be affected by water much more quickly than the straight nitroglycerin dynamites.

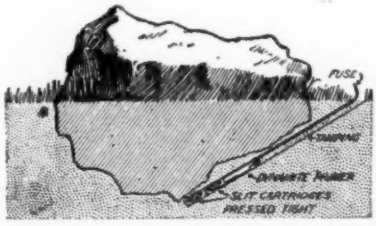
Blasting Boulders

The removal of boulders in the right of way of new roads is a problem difficult of solution. Dynamite materially assists in the work by shattering the boulders to one-man pieces or into such sizes as can be easily accommodated by a portable rock-crushing outfit. For boulder blasting there are three distinct methods of loading—block-holing, snake-holing, and mud-capping.

The oldest or block-hole method of blasting a boulder is to drill a hole in it and load with a small amount of dynamite. This hole should be so located that the charge of dynamite loaded in the bottom is near the center of the boulder. By this method the hardest boulders known can be shattered. For such work 40 per cent dynamite is recommended, but if only a small amount is to be done, weaker grades are satisfactory. For large boulders, the bore holes should be at least 1¼ inches in diameter. This will permit the loading of unbroken cartridges of standard size. The amount of load for each hole will vary with the size and hardness of the boulder. For extremely large boulders and ledges several holes should be used and fired with a blasting machine. For small boulders the holes may be made with a hand drill and may be smaller than 1¼ inches in diameter. In such a case it will be necessary to remove the dynamite from the paper shell and press it into the hole. The cap is then inserted into a hole which has been made with a pointed stick in the packed charge of dynamite. After loading bore holes of this kind, the charge must be confined by tight tamping.

In breaking boulders by the snake-hole method, holes are made in the ground under the boulder with a crowbar, drive point, punch bar or auger, so that a charge of dynamite can be placed immediately under and against the heaviest and strongest part of the boulder. The dynamite for this work is 40 per cent strength, but if stronger dynamite is already on hand it can be used to good advantage. This is packed tightly in the bottom of the bore hole, after which the hole is tamped full and the shot fired. Such a blast, if properly loaded, will lift the boulder out and shatter it into fragments which can be handled. This method with light loading can be used for lifting out boulders when it is not desirable to shatter them in place. Either blasting caps and fuse or electric blasting caps may be used for detonating.

The mud-cap method of boulder blasting is also called "blistering," "bull dozing," or "doby shooting." Pick out the point on the boulder where it would be struck with a hammer if it were possible to break it with one. For large boulders, where a heavy load will be necessary, the cartridges may be laid in a neat pile on the boulder at the point selected, leaving as little air space between them as possible, with the primer cartridge in the center. This should then be covered and surrounded with a heavy cap of mud, or moist clay or loam, to a depth of at least 6 inches. For small boulders where only a light load is necessary, it is better to remove the dynamite from the paper shells and press it closely against



CORRECT WAY OF BLASTING A BOULDER BY THE SNAKE HOLE METHOD

the boulder in a low pyramid, inserting the cap into this pile of dynamite and surrounding the charge with mud as has been described. Where boulders are imbedded in the ground, better results will be obtained if the ground is dug away from the sides before blasting. A sufficient length of fuse or leading wire should be used to permit the blaster to be at a safe distance from the blast. This is the easiest way to break boulders, but it is also the most expensive. The same amount of explosives will break many more boulders if used in block-holes. Never use the mud-cap method unless the amount of work to be done is so small that expense is not a serious consideration, or unless the rocks to be broken are flat and not deeply imbedded in the ground. Nitroglycerin dynamite of 60 per cent strength has been found best for this work.

MUD CAPPING A BOULDER

No fixed rules can be laid down for the selection of the best method for blasting boulders in any locality, on account of the variation in the cost of drilling and the hardness of the boulders. The labor cost is greatest for the "block-hole" method and least for "mud-capping," with the "snake-hole" method an intermediate. The cost for dynamite is exactly the reverse. Where boulders are flat and not imbedded deeply in the ground, mud-capping is usually the most economical. Where the boulders are not abnormally thick or hard and are resting on a solid foundation, the snake-holes are quite satisfactory, but for very hard, large boulders, block-holes are preferable.

Making Cuts

In making cuts through tight clay or shale, the cost of excavating can be materially reduced by loosening the clay or shale with dynamite. For such work, holes are put down from the surface to a point slightly below the grade of the desired cut. As a general rule, these holes should be spaced about 6 feet apart each way and loaded with two or more cartridges of 40 per cent dynamite. The burdens—the distance from the face of the cut to the line of holes—and the spaces between the holes should always be a little less than their depth. While such a series of shots may be fired with caps and fuse, better execution will be secured by firing a number of holes at the same time with electric blasting caps and a blasting machine. Such a blast will not only shatter the clay or shale so that it may be easily handled by shovels or scrapers, but will also throw much of it out of the cut so that it will not require rehandling.

In cutting through solid rock, it is best to begin at the end of the cut at the desired grade and remove the rock in vertical benches rather than in layers, as is the practice when cutting through earth when scrapers are used. For cuts less than 6 feet in depth, start back on the rock a distance equal to the depth of the cut and drill holes down to one foot below the grade. These holes should form a line across the cut and should be spaced a distance apart equal to the distance they are back from the face. For holes deeper than 6 feet, go back 6 feet on the rock and space the holes 6 feet apart. Dynamite of 40 per cent strength is recommended for this work.

The illustrations for this article were provided through the courtesy of the Hercules Powder Company, Wilmington, Del. This company publishes a very interesting booklet entitled "Modern Road Building and Maintenance," which may be secured gratis by contractors and engineers interested in economical road building.

The Mechanical Handling of Stone and Gravel from Railway Cars to Trucks or Wagons

By Alan Mair Jackson
Engineer, County of Brant, Ontario, Can.

THE usual methods of transferring crushed stone from railway cars to wagons or trucks may be outlined as follows:

1. Shoveling by hand over the sides onto the ground and shoveling again into wagons
2. Shoveling by hand over the sides direct into wagons
3. Shoveling into skips on the side of the car which can be tripped into wagons
4. Shoveling by hand over the sides and loading with a mechanical loader
5. Dumping hopper-bottom cars and loading with a mechanical loader
6. Dumping hopper-bottom cars over a slot in the track, the bottom of which is inclined so as to discharge onto an elevator, which in turn discharges to a stock pile or storage bin.

Last year, with wages at 40 cents per hour, the cost of unloading by hand amounted to 20 cents per ton, when the material was shoveled out of flat-bottom cars with 3-foot sides. The cost of shoveling from hopper-bottom cars would be more. In fact, the prevailing price for which coal unloading by hand is contracted around Brantford is 30 to 40 cents per ton. These may fairly be taken as average prices.

Shoveling by hand obviates demurrage, but entails an expenditure of almost as much as the unloading charge for reloading again into the wagon, while the reloading by hand into motor trucks higher than wagons would probably bring the cost of reloading up to 30 cents per ton. This method of handling stone is primitive and entails having other work available at which the gang of shovelers can be placed until another car is spotted. It is practised only for small quantities of materials where the cost is not likely to be less than 50 cents per ton.

Shoveling by hand out of cars direct into wagons or trucks is obviously considerably cheaper than the first method, because it entails handling the material once only instead of twice, but it costs more than one handling of material. This is because of the time lost by the teams standing idle while they are being loaded. With men at 40 cents and teams at 80 cents per hour and with 1½-yard wagons, the cost of unloading cars is 31 cents per ton. This applies to flat-bottom cars with the teamsters shoveling; the increase in cost over shoveling onto the ground was due to the idle time of teams and shovelers, principally the former. Every locality has its peculiar advantages or disadvantages. Some have the advantage of a raised track and a sunken wagon road, so that cars may be shoveled more cheaply by first dumping them than by lifting the material out over the side, but, considering the case of wagons on a road at the same level as the track, the cost of 31 cents is quite usual.

No simple mechanical method has yet been found of unloading railway cars of stone from the top, and it would seem that when cars have to be unloaded from the top the man with the shovel will long hold his own. One method, however, of making an economy on what must always remain an expensive operation, is the use of loading skips. These are fastened to the side of the car, or stand independent of it but close by, and hold about 1½ yards. Two or three may be used on one car. The skips are filled by the shovelers while the wagons are away discharging, and the wagon is very rapidly filled by tripping the skip so that by a little arranging of the number of teams and shovelers very little time is lost by either.

A considerable improvement over the above methods is brought about by the mechanical wagon loader, several of which are now on the market. One type in particular can be used to very good advantage from the stock pile, and another for unloading hopper-bottom cars. These ma-

chines are both portable and are of two distinct types: one, with a chain of buckets which digs into the pile, and the other with a belt conveyor which requires that the material fall onto the belt or be placed there. Both types deliver at a height suitable for loading a wagon, truck or trailer.

The difficulty of shoveling into a pile of loose broken stone is well known, and this is the difficulty which is presented to the bucket type of loader. It is a difficulty which increases with the size of the stone, and is very real when the pile consists of small gasoline engines not usually requiring highly skilled operators, either of these types can be successfully handled at very little over ordinary unskilled wages. The bucket machine undoubtedly works better in gravel than in broken stone, and costs in the neighborhood of $1,800. The second type, with the simple belt conveyor, is a cheaper machine, costing about half as much as the former, but it requires considerably more feeding, in that it does not dig into a pile but must have the material fed to it. It requires about 3 h. p. and is

A HANDY METHOD OF LOADING TRUCKS FROM RAILWAY CARS BY HAND

Heltzel Lightning loaders attached to the sides of the cars are filled by hand shoveling while waiting for the truck and are tripped, quickly loading the truck and minimizing delays

4-inch and upwards, such as is used for base course road work. This type will load a wagon in upwards of a minute and a half under favorable conditions, and is operated by an 8-horsepower gasoline engine. Under the old rule of 1 pint per horsepower per hour, this would bring the cost of running to about $3.50 for gasoline per day of 10 hours. It would be unusual to run at full load for 10 hours, on account of the difficulty of having an empty wagon or truck always ready to take the place of a loaded one. It may, however, be considered that 1 cent per ton is a fair cost for fuel. With usually operated by a gasoline engine. By the use of this machine two men can unload a 50-ton car of coal in about 4 hours. This type operates well under a hopper-bottom car, as the car can be dumped after the toe of the elevator has been set in under the pocket, and so long as the material runs to it, the elevator will automatically carry it away. Owing, however, to the construction of hopper-bottom cars, the four pockets of the car each have a door; two of the four doors at one end of the car open simultaneously when dumped, and consequently there is a gush of material which runs out

onto the track for more than the full width of the car. It will thus be seen that with the elevator set in under the pocket on one side, considerable material will run out of the pocket on the opposite side. Moreover, when one pocket has discharged itself, the opposite side must be shoveled out by hand, and these contain on an average 5 tons. It will thus be seen that in unloading a 50-ton car probably 10 tons has still to be shoveled by hand.

These two types of wagon loaders are capable of a variety of applications and have very real spheres of usefulness, not only in unloading cars but also in loading to and from stock piles and in gravel pits. The lack of storage, however, puts these machines in a different class from those which are operated in connection with a storage bin.

The most economical method of handling stone from railway cars to wagons or trucks is by the slot, elevator and bin method. A slot 4 feet deep across the track is excavated 16 inches wide between ties, and is lined with ties set one on top of the other. A plate some 9 feet long by 16 inches wide is set in this slot at a slope of about 30 degrees from the horizontal, so that the stone runs freely. The plate should be set so that the largest material will pass under the rail at the upper end, and the lower end should be set so that it will discharge onto the buckets of an elevator. The elevator is set in a pit at one end of the track with the center of the lower tumbler about 5 feet below the base of the rail. With this setting, a 30-foot elevator standing at 60 degrees from the horizontal will have sufficient length to fill a 55-ton bin. The motor is usually a 9-horsepower oil engine, and is set under the elevator in a small portable house. It is provided with a clutch drive, by a 6-inch belt, onto the jack shaft of the elevator. The elevator is of standard construction, 14 inches wide, and delivers about 120 buckets per minute. The flow of stone onto the elevator is controlled by an ordinary slide door operated by a lever, and is set between angles fastened to two plates lining the side of the 16-inch slot at the lower end. The pit in which the elevator is set is made large enough for the operator to get down to the lower tumbler, and is timbered on the track side and decked over. A trap door is left in the deck so that the lever operating the stone feed may be reached, and cover boards are provided for the slot across the track so that the whole may be left safe when not in operation. The usual spacing of ties is about 20-inch centers, which leaves approximately 11 inches between ties. Railway companies will usually give permission for ties to be spread to an opening of 16 inches on sidings if a piece of rail is put in under the running rails as an extra support. Two of these outfits were installed by the County of Brant last year and operated during the construction season. The cost of unloading cars and loading into wagons by this method has been about 3 cents per ton. The total kerosene purchased at 20½ cents for unloading 1,854 tons was 33 gallons, giving a cost for fuel of about 0.4 cent per ton. A 50-ton car can be unloaded in 2½ hours, though, allowing for oiling and starting up, 3 hours would be a fair allowance. The operator in each case has been an unskilled man paid 40 cents per hour. The bin used discharges through four 12- x 12-inch openings in the bottom, from any one of which a 1½-yard wagon can be filled in 30 seconds. The height from the ground to the bottom of bin is 6 feet 8 inches; this can be increased by lowering the roadway. The cost of unloading 50 tons was as follows:

3 hrs. time at 40 cents	$1.20
50 tons at 4/10 cent for fuel	.20
Oil, waste and grease	.10
	$1.50

These outfits cost approximately $1,800, made up as follows:

Engine and clutch	$545.00
Elevator	650.00
Lumber for bin and pit	215.00
Ironwork for bin and slot	225.00
Construction	165.00
	$1,800.00

The unloaders can be taken down and re-erected for about $200.

A bin of this capacity is not portable in the strict sense of the word, but the bins used in Brant County last year were made so that the whole structure could be readily taken apart. No nailed parts would have to be torn out except the lining boards of the end of the bin, each of which requires two 4-inch nails, so that no loss should occur in knocking down the bin.

In most counties stone unloading points can be located on the railways, from which

several seasons' work could be done.

The commonest method of unloading cars is to shovel out into wagons, which will cost in the neighborhood of 31 cents per ton, or $15.50 for a 50-ton car. Taking the cost of unloading by the slot, elevator and bin method at 3 cents per ton, or $1.50 for a 50-ton car, a saving can be effected of 28 cents per ton, or $14 per car. A season's work for one macadam outfit might be fairly placed at one car per day for 140 working days. This would represent a cost of $2,170 for unloading by the one method and of $210 for the other, or a saving of $1,960 for one season, a little more than the cost of the outfit.

ACKNOWLEDGMENT.—From a paper read at the Sixth Annual Conference on Road Construction, Toronto, Canada.

Machinery vs. Hand Labor in Unloading

THE difference in cost between loading and unloading materials by hand labor and doing the same work by machinery is so immense that the installation of a clam-shell bucket for such work has become a genuine necessity. Crushed stone, sand, gravel, coal, coke, ashes, earth, clay, silt, chemicals, ores and the like may be dug and hoisted to any practical height in one operation by these grab buckets at one-tenth the expense of hand labor. Transferring material from one place to another implies the need of machines arranged to operate clam-shell buckets. Among these are the locomotive cranes, mast and boom hoisting plants, traveling towers, movable bridges, telpher systems, dredges, navy colliers, lighters and all derricks, such as the stiff-leg, the guy, the traveling, the skid excavator types.

NO. 1.—LOCOMOTIVE CRANE WITH CLAM-SHELL BUCKET

NO. 2.—CLAM-SHELL BUCKETS ON LIGHTERS

Nearly everyone appreciates the fact to-day that the rapid handling of raw materials for the steel, the coal, the chemical, the cement and the construction industries has been and will continue to be one of the most important factors in the commercial growth of this country. Recently a marked tendency, notably among small concerns, has developed toward substituting digging machinery of the clam-shell bucket type for hand labor where materials are to be stored or reclaimed, even when the quantity handled is as little as 1,500 tons per year. The George Haiss Mfg. Co., 143rd Street and Rider

NO. 3.—SCOW EQUIPPED WITH CLAM-SHELL BUCKET, 10-TON HOPPER AND CHUTE

Avenue, New York City, equips complete hoisting plants operating clam-shell buckets from ¾-cubic yard upward in capacity.

The Berkshire Iron Works of Sheridan, Pa., owns the "High Power" clam-shell bucket operated on the locomotive crane shown in illustration No. 1. The bucket has been utilized on a large variety of work, digging iron ore, coke, coal, sand, etc., without need for attaching teeth to the cutting jaws.

In illustration No. 2, three "Contractor" clam-shell buckets are in evidence. All the floating derricks are of similar design and built upon broad scows. When in service the lighters tie up to any wharf in a river or harbor, and a boat loaded with stone, sand or coal is then brought alongside. When the bucket is dropped, it digs into the crushed stone, is closed, swung over, and discharged into a hopper for loading trucks on the wharf. Sometimes the boom is swung in both directions by means of a steam swinging gear, and sometimes by means of a sluing line held by a man tightly around the nigger-head of a two-drum hoisting engine. In the latter instance the lead of the hoisting cables permits the boom with an empty bucket to swing back over to the stone boat automatically through the force of gravity, the sluing line coming into action only when the boom is brought around with a loaded bucket.

Another type of floating derrick that has proved successful on account of complying with certain restrictions enforced on public wharfs, is the one illustrated in view No. 3. A contractor delivering coal, sand, stone or similar materials can usually obtain permission to dock at some place near where the cargo must be finally delivered on shore. On the forward end of the deck on this particular type of unloading machine a 10-ton hopper is erected sufficiently high to permit its discharge chute to clear over the trucks loading on the wharf. The hoisting speed attained with any capacity of the "Contractor" type clam-shell bucket on this kind of unloading plant usually averages two round trips per minute.

The boom on this floating derrick swings automatically by reason of the method employed in leading the hoisting cables back from the upper boom end to the "A" frame of the derrick; that is, the two cables are spread apart to each side of the "A" frame, and when the bucket closes on a load, the closing rope, besides raising the bucket, also causes the boom to bear over toward the hopper. When the boom is in position over the hopper, the closing line is released and the bucket discharges. To bring the boom and bucket back over the stone or coal boat, the other, or holding, line, upon receiving the weight of the empty bucket,

NO. 4.—CLAM-SHELL BUCKET ON TRAVELING "A" FRAME DERRICK

produces the same effect on the boom as the closing line did, but in an opposite direction. Because of this simple boom control, the hoisting engine need consist of only two drums, and the number of motions of the hoisting engineer are reduced 50 per cent. Aside from the simple and effective mechanical features, the low first cost of this unloading plant also may influence a purchaser to some extent.

A familiar scene is reproduced in illustration No. 4. Anyone acquainted with the present-day equipment of a profitably operated sand and gravel plant will recognize that the excavating machine shown here in action is a traveling "A" frame derrick. This one moves on rails, but often similarly constructed derricks are moved over the ground on skids and are then referred to as skid excavators. The "Contractor" clam-shell bucket is digging sand and gravel both above and below the water in this pit, and discharges the mixed materials over a "grizzly" screen; the fine sand and small gravel drop into a hopper below, from which cars hauled by cable are loaded for the big screening plant located at the top of the sand-pit.

The Heavy Hauling Problem of a Cleveland Gravel Company

SIX miles outside of Cleveland, Ohio, the Diamond Sand and Gravel Company operates one of the largest sand-pits in the country. From here a fair percentage of the sand used in the numerous building operations about Cleveland is secured. The pit itself, together with a number of smaller ones, lies a quarter of a mile back from the main Akron-Cleveland highway, a dirt road having been constructed across the railroad tracks back to the pit.

It costs the Diamond Sand and Gravel Company nearly $150,000 a year for merely stripping the ground, that is, clearing off the top layer of dirt to get at the sand, which is packed amazingly tight. The sand is blasted out, using six sticks of dynamite to a charge. The position of the pit makes it rather difficult to get the sand out, especially in wet weather, but the motor trucks pull out over the poorly constructed dirt road and carry 5 yards away at a trip.

H. F. Lashbrook, a hauling contractor, operates nine 5-ton Selden dump trucks on this job, hauling all the sand used by the Ohio Coal and Supply Company. The trucks are equipped with 5-yard bodies, which, loaded with a steam shovel as shown in the accompanying illustration, carry a load of nearly 7 tons; the sand weighs 2,700 to 3,100 pounds per cubic yard, depending upon the moisture it contains. The longest haul made is 15 miles one way, the average being five loads daily, making at least 40 miles. The cost of operation on these sand-pit hauls is rather high, on account of the terrific strain on the truck, caused by the road and load conditions. The total cost is a trifle less than $30 per day. Figuring the average of 5 loads at 5 yards each, this makes a yardage cost of $1.20, which, after all, is very reasonable for an average haul of 5 miles. This includes all items, a very liberal driver's wage, full coverage insurance and liability, and property damage alone running $80 per year. Mr. Lashbrook's records show an average of $250 a year for running repairs on these trucks. This makes an average of a little over 2 cents per mile, which is considered very reasonable under the operating conditions.

In addition to this profitable business, Mr. Lashbrook also has five platform stake Selden trucks of 3½-ton capacity, used mostly on freight station hauls for various manufacturing companies. These trucks do not have the hard service given the sand hauling trucks, and average about 30 miles a day.

A garage is maintained in charge of a mechanic and a helper to keep the trucks in excellent shape; Mr. Lashbrook believes in giving the trucks the proper care, although he never hesitates to load them to the limit. In fact, one of the loaders at the pits said, "He doesn't overload, he just doubles." Even with the big overload, the drivers deserve much credit for the work of the truck. Each one is handled carefully and efficiently. With careless drivers Lashbrook's trucks could not have made such an excellent record, for a better place to demolish a truck on regular hauls would be hard to find. The heavy loads and rough going cause tremendous strain on every part of the truck.

The driver problem is always a big one, but Lashbrook solved it with a bonus plan that is efficient but very simple. He figures that $25 a day will pay his costs on an average, as he had both 3½- and 5-toners, and this amount he has made the minimum. The drivers receive 20 per cent of all their trucks make over this amount, while the garage superintendent receives 5 per cent. Lashbrook pays his drivers from $75 to $125 a month on bonuses alone. The drivers are satisfied, are strong boosters and stick to the job, taking care of the trucks and also of their time. It pays to consider the drivers, and this plan has been profitable to both owners and drivers of trucks in many places.

A New Type of Body for Garbage Collection with Hydraulic Hoists

A new water-tight steel body with Hydro hoists, particularly adapted to garbage collection, is manufactured by the Heil Company, 1243 26th Avenue, Milwaukee, Wis. This company also manufactures a complete line of dump bodies, asphalt bodies, Hydro hoists and welded tanks for all purposes. The illustration herewith shows a Winther motor truck recently placed in service by the city of Madison, Wis., fitted with a Heil steel body and Hydro hoists. The bodies have six covers, the front four of which open from the sides and the two back ones from the rear. Adjustable steps at the sides and end of the body make it easy for the collectors to dump garbage cans into the body. The bodies are made of No. 10 gauge steel with covers of No. 12 gauge. In constructing the bodies, they are first riveted and then all seams are welded. This method of construction prevents liquid garbage from dripping onto the street. For dumping, the tail gate is hinged at the top so that it swings open when released. Four wing nuts are used to keep it tightly in place when the body is loaded, holding it firmly against the packing which is inserted between the tail gate and body. The body itself is 3 inches wider at the rear than at the front, so that the load will dump freely. The body is furnished with a Hydro hoist, which permits the body to be placed just back of the cab, thus utilizing all of the loading space and making possible a body with lower sides. The bodies have a capacity of 81 cubic feet and when not built with the covers described above are provided with loops so that a canvas cover can be tied tightly over the load.

WINTHER TRUCK USED BY THE CITY OF MADISON, WIS., FOR GARBAGE COLLECTION

Addition to Heil Plant

The Heil Company, Milwaukee, Wis., manufacturer of steel tanks, bodies and hoists for motor trucks, is building a new addition to its plant, measuring 136 x 250 feet, or about 35,000 square feet in all. This will make the Heil plant total 150,000 square feet. The new addition will be used for storing material and as a mounting department for dump bodies and hydro-hoists. The storeroom will be equipped with all necessary machinery for fabricating material which will be fed to the existing shops. The department for mounting bodies and hoists is receiving a great deal of attention by the company at present, as hundreds of county highway commissioners are having their trucks equipped with hydro dumping equipment, which is one of the most approved types on the market to-day.

This Steam Shovel Equipped with a Continuous Tread Truck

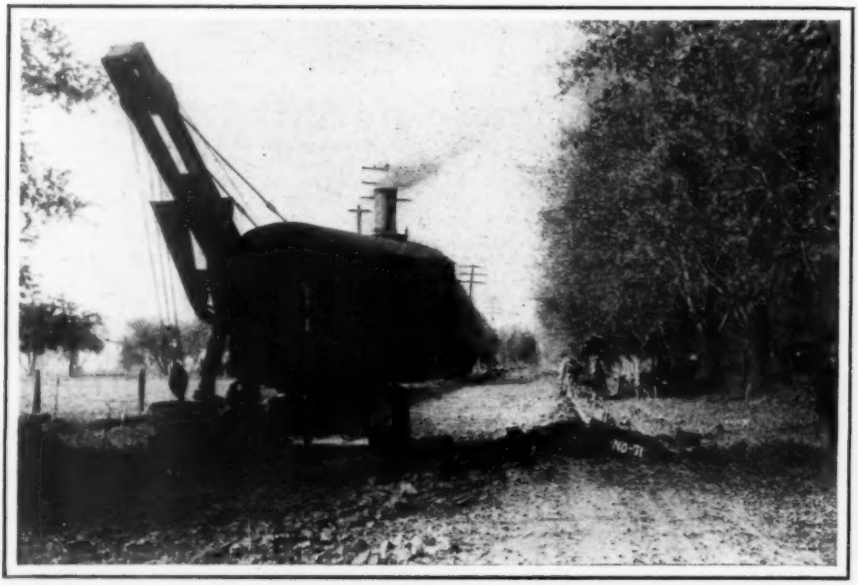
THE advantages gained by the use of a continuous tread traction for revolving steam shovels has led The Osgood Company, Marion, Ohio, to so equip their Osgood 18, a ¾-yard revolving steam shovel. A number of these machines have now been placed with some of the most reliable contractors and engineers, who have praised their performance. The continuous tread trucks are interchangeable with traction wheel trucks and are easily attached to the under side of the case steel truck frame. The outfit is very compact so as to interfere as little as possible with the operation of the dipper, and consists of two endless tread belts carried by adjustable steel side frames which are joined by two cross-axles, with the truck frame resting on the axle.

The treads are composed of pressed steel pans with oak filling, bolted to heavy cast steel links connected by hardened steel pins and passing around octagonal tumblers at the ends and supported on the bearing side by large rollers or wheels. Power for moving is taken from a cross-shaft underneath the truck frame to the driving tumblers on each side by means of two heavy sprocket chains. The chains are engaged to the driving tumblers with jaw clutches and are readily disengaged for steering. A simple locking device is provided for the disengaged tread belt, which insures a short turning radius when desired.

The machine has an especially high and wide dumping radius, as shown by the illustration of the shovel owned by Bentz Brothers, now working at Mogadore, Ohio. The value of this feature is obvious to contractors interested in cellar or basement excavations, for it permits them to load their wagons or trucks directly on the bank, thus doing away with expensive and troublesome snatch teams. All Osgood 18 shovels are so constructed that they can easily and readily be equipped with a structural steel boom, boom hoist, etc., for drag-line, clam-shell or crane work. For such work the machine is generally equipped with a 30-foot boom, and when used for clam-shell or drag-line service is equipped with the regular ¾-yard bucket.

AN OSGOOD "18," EQUIPPED WITH CONTINUOUS TREAD, WORKING IN A TRENCH IN MOGADORE, OHIO. THIS OUTFIT, OWNED BY BENTZ BROTHERS, IS EQUIPPED WITH A ¾-YARD BUCKET

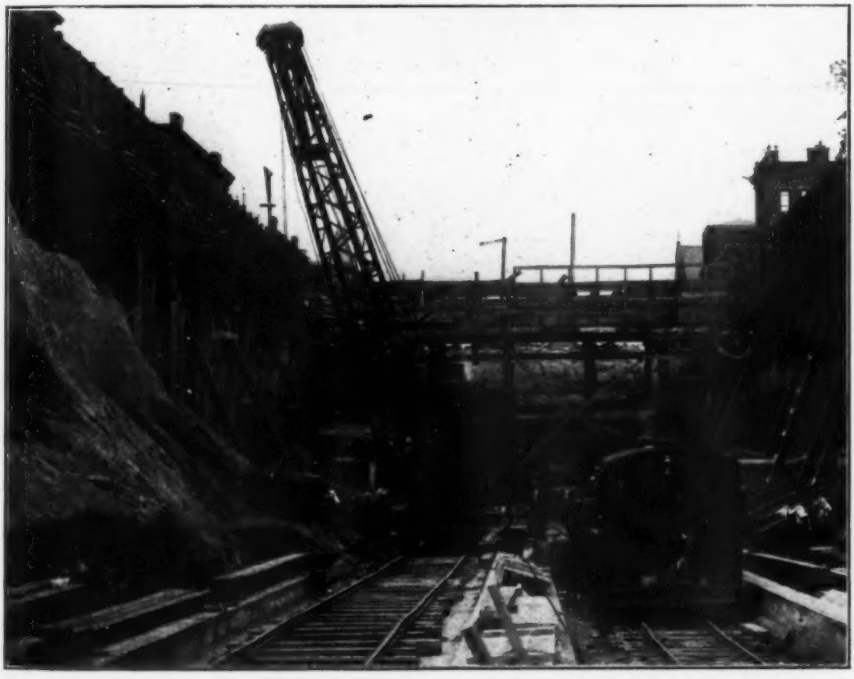
Contractors' Mechanical Allies



A THEW THAT WANDERED OFF INTO THE COUNTRY AND MADE GOOD ROADS ALL THE WAY

WARRICK COUNTY, IND., BELIEVES IN WELL-EQUIPPED MOTOR TRUCKS FOR ALL-ROUND WORK. THIS STEWART TRUCK WITH DUMP BODY HAS SEEN HARD SERVICE THROUGHOUT THE COUNTY

TWO HEAVY-LADEN FEDERALS ON THE THIRD AVENUE HIGHWAY, BIRMINGHAM, ALA. THIS ROAD HAS BEEN DOWN OVER THREE YEARS AND HAS COST ONLY $12.50 A MILE TO MAINTAIN



A 4-WHEEL LOCOMOTIVE CRANE MANUFACTURED BY THE BROWN HOISTING MACHINERY COMPANY, HANDLING CONCRETE AND EXCAVATION ON THE FOURTH AVENUE SUBWAY, NEW YORK, FOR THE TIDEWATER BUILDING COMPANY AND THOS. B. BRYSON

Proposed Contract Provisions

Recommendations of the Committee on Contracts of the Associated General Contractors of America

SINCE an analysis of income tax returns shows that contracting is the most hazardous industry in the country, it was deemed advisable by the Committee on Contracts to include sixteen protective provisions in future contracts to endeavor to eliminate in an entirely equitable manner as much of the hazard of bidding and construction as possible. An outline of the suggestions is given in the following paragraphs:

1. Bids should be submitted with the provision that they must be acted upon within a reasonable time.

2. Bids should be submitted on the basis of existing freight rates, with the provision that in case a change in rates should occur between the times bids are received and the date fixed for the completion of the contract, the contract price should be increased or decreased accordingly.

3. A similar provision is made with regard to wages.

4. Bids should be submitted on the basis of existing prices for materials f. o. b. the producer's plant or distributor's yard, with provisions similar to those in paragraphs 2 and 3 with regard to increase or decrease in price.

5. Monthly estimates should include materials delivered and suitably stored as well as materials incorporated in the work.

6. Certificates should be prepared and delivered to the contractor between the first and tenth days of each month showing the proportionate part of the contract price earned during the preceding month. These certificates should be paid by the owner by the tenth day of the month. Interest on deferred payments should be paid the contractor at the prevailing rate.

7. Under the following conditions, the contractor should have the right to stop work or terminate the contract upon three days' written notice to the owner and architect or engineer and recover from the owner payment for all work executed and any loss sustained upon any plant or material, and reasonable profit and damages:

(a) If the work should be stopped under an order of any court, or any public authority, for a period of three months, through no act or fault of the contractor or anyone employed by him;

(b) If the architect or engineer should fail to issue the monthly certificate for payment in accordance with the terms of the contract;

(c) If the owner should fail to pay the contractor within seven days of its maturity and presentation any sum certified by the architect or engineer or awarded by arbitration;

(d) If the owner does not permit the contractor to proceed with the construction within a reasonable time after signing the contract.

8. The retained percentage should be based on 100 per cent of the work performed and should never exceed 10 per cent. When the amount reaches a total sum which should be mutually agreed upon between the owner and the contractor, no further reductions from payments should be made.

9. When a surety bond is given, it should be reduced at agreed intervals so as to cover thereafter only that portion of work then uncompleted.

10. Whenever any provision is incorporated in the contract for a penalty against the contractor (including liquidated damages), there should also be inserted a provision for a bonus of like amount.

11. The contractor should not be held responsible for results arising from the act of God or a public enemy.

12. The time allowed for the completion of the work should be based on "weather working days" instead of on elapsed time, and, if necessary, allowance should be made for time spent in performing unproductive work made necessary by floods or other natural causes beyond the control of the contractor.

13. Where practicable, material should be inspected at the source so that costly delay may not result from the rejection at the site of the work, of materials furnished in good faith by the contractor.

14. Payment for force account work should be made on the basis of the total actual costs of the work, including the actual labor and material costs, rental on equipment, liability insurance, etc., plus a reasonable percentage to cover overhead and profit, total not to be less than 15 per cent.

15. In case the actual quantities of any item in a unit price contract are less than the estimated quantities by more than a certain fixed per cent, the unit price paid the contractor for that item should be increased by an amount to be agreed upon. Similarly, a decrease in the unit prices should be made in case the quantities are increased over the estimate by more than a certain fixed per cent.

16. In no case should the architect or the engineer be made the final judge as to the interpretation of the drawings and specifications or the performance of the contract. All decisions and interpretations should be subject to prompt arbitration at the choice of either party to the dispute.

(Constructive criticism of these recommendations is invited)

A Six-Wheel Truck—A New Development in Hauling Facilities

WHAT may prove to be a big step toward solution of the problem of ultimate tire equipment for heavy pay-loads on motor trucks is the recent development of a multiple-wheeled truck by engineers of The Goodyear Tire & Rubber Company. Actual demonstrations and close tabulation of results indicate clearly that this "six-wheeler" or tandem axle construction truck with four pneumatic equipped rear wheels has steadier riding qualities, better traction, is less destructive to roads, decreases tire weight and cost, reduces axle weight, has greater braking capacity and permits greater operating radius.

Development of this type is due to the strong conviction of P. W. Litchfield, Goodyear factory manager, expressed at a recent meeting of the Cleveland and Detroit sections of the Society of Automotive Engineers, that the heavy-tonnage truck of the future would be some form of multiple-wheeled vehicle, just as the multiple-wheeled freight car succeeded the single-truck type for hauling heavier loads. However, the "six-wheeler" was not developed in an attempt to produce the ultimate motor truck, but to attempt to solve the problem of pneumatic tire equipment for heavy pay-loads.

As tire cost and weight are perhaps the greatest factors of interest to truck owners, it will be interesting to note that instead of using the giant 48 x 12 pneumatics, weighing about 398 pounds each, on the rear of 5-ton trucks, the tandem axle construction embodied in the new six-wheel truck allows the use of four 40 x 8 pneumatic tires weighing 119 pounds each, a reduction of 279 pounds in the weight the driver on tire changes will have to lift. In addition, the four smaller pneumatics cost one-third less than the larger tires.

As the same size of tire is used all around on the truck, the 8-inch tire can also be used as a front wheel spare, still further reducing the tire investment and the number of spares necessary to insure continuous operation.

No more appealing feature can be found for municipalities than that of road saving, demonstrated by the pneumatic-equipped "six-wheeler." The average road has the maximum base practicable and begins to disintegrate under the excessive pounding of solid tires. With the truck weight distributed on four rear wheels, road and truck engineers estimate that the average road will withstand a load up to 7 tons under newly developed construction with no more destructive effect than that resulting from the 3½-ton load on two rear solid tires. Road saving has a tremendous popular appeal, so that such a quality in the new type would not only offset unfavorable sentiment against the use of highways by heavy vehicles, but would also be a great stimulus to larger appropriations for road improvements.

One striking advantage of pneumatics on the tandem axle construction is, that they permit a much greater operating radius and steadier riding qualities. The "six-wheeler" seems to cling to the road and rides so

THIS TRUCK MARKS AN EPOCH IN MOTOR TRANSPORT. IN A FEW YEARS WE MAY SEE PRACTICALLY ALL EXCESSIVE LOADS CARRIED ON TRUCKS WITH 6 WHEELS

steadily and with so little vibration that when a glass filled with liquid to within an inch of the top was placed on the rear of the truck, none of the water was spilled, even when the vehicle traveled over rough roads. When passing over an obstruction, the chassis raises but half the distance it would have in the regular type of construction, and by reducing shocks and vibration proves possession of exceptional riding qualities, to the intense satisfaction of the driver. In recent hauling tests from Akron to Cleveland, such cushioning effect was produced by the smaller pneumatics and the multiple wheel construction that with a 5-ton load the truck traveled 48.6 miles at an average speed of 26 miles an hour, and registered 8 miles an hour average speed in heavy traffic while leaving Cleveland.

With an area of road contact 27 per cent greater than that of two 12-inch pneumatics, the four 8-inch tires showed much better traction qualities. This was especially noticeable in comparison with dual solids or pneumatics on highly crowned roads and in soft going, where additional traction surface kept the wheels from sinking in deeply and the truck from stalling. Increased ease in handling seemed to be one of the truck's most prominent features.

With the large saving in tire weight by the use of smaller pneumatics as a large factor, the total axle weight is greatly reduced in the new type of truck. Greater braking capacity is also obtained by this construction, four brakes being used instead of two.

The chief objection expressed by engineers to the use of 48 x 12 tires has been the extremely high center of gravity, the truck load being raised to an extreme height above the ground. This objection is entirely overcome by the use of the four smaller tires.

A Valuable Book for Pump Users

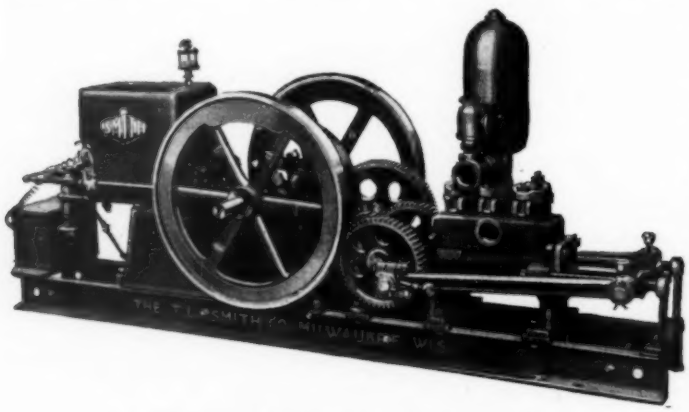
Pump users will find the pamphlet "Never Failing Water," an interesting and instructive piece of literature in which the subject of pumps is treated in an exhaustive manner.

Contractors and road builders will find it interesting, because it contains pump statistics on uses in connection with paving machinery. It shows, by example, how to figure the size of a pump necessary to supply a certain gallonage of water from any specified distance. It shows the friction loss developed by the passage of water thru pipes of various sizes. It has a set of statistics showing the amount of friction contributed by pipe fittings, such as elbows, bends, valves, etc. Handy charts show, at a glance, the quality of water contained in rectangular or circular tanks of various dimensions. In addition, it gives some valuable operating hints, which will enable the user to get more efficiency out of his pumping outfit.

The book tells, too, about the complete line of Smith pumps, which includes force, diaphragm and centrifugal outfits of various sizes. Smith pumps have made an enviable reputation for themselves, by their record of consistent performance. This is largely due to the principle of extreme simplicity on which they are constructed. Fewer working parts are used, and the design of the pump is such that any part can be removed without dismantling other parts.

The Smith high-pressure force pump is the only double-acting force pump with a double train of gears which has the jack bearings cast integral with the pump. This construction insures perfect and permanent alignment of the shafts and cross-head pinions—a very important feature, and one which contributes greatly to the long life of Smith pumps.

The book "Never Failing Water" will be gladly sent to interested parties. Write the T. L. Smith Company, General Sales Offices, Old Colony Building, Chicago, Ill.



A CONTRACTOR'S PUMP THAT STANDS THE GAFF

Dealing Fairly with the Municipal Contractor

Frequent Inconsistencies Met with in Specifications

By Wm. C. Fraser
Contractor and Engineer, St. Paul, Minn.

IN drawing up specifications the Engineer should prepare them from actual measurements and surveys and know that the quantities given are correct; that the plans, specifications and estimates show everything that will be needed to complete the work. If this cannot be ascertained, the specifications should so state and should contain a cost-plus-percentage clause allowing extras for unforeseen material and labor needed. The Contractor should not be expected to bid on the quantities given and shown on the plans and then guess at what additional work the Engineer may see fit to require before the contract is accepted.

The Engineer should not expect the Contractor to comprehend what will be needed when he does not know himself. The proper way to cover the unforeseen is to have it classed as extras and paid for at cost-plus-a-percentage for use of tools, superintending and profit. The Engineer should take the time necessary to properly prepare the plans and specifications, and should be properly paid for doing so, for when he guesses at the quantities of material needed and makes an incomplete survey, he only damages his own reputation and makes trouble for himself, as well as for the Contractor. In the majority of cases the city council wishes to have the best kind of work done and is willing to pay for it. Most Contractors construct first-class work that is not only a monument to the Engineer, but will stand as a recommendation for the Contractor. We all know that there are Contractors who are only after the money that can be made out of the work and whose only object is to get through with the contract, secure their money and let the Engineer and the city council make the best of it. The Engineer should see that Contractors of that class are not allowed to secure any work under their plans and specifications, and thereby encourage the Contractor who is willing to do right by the Engineer. In time this would create a better class of Contractors bidding on municipal work. It is almost impossible for a good Contractor who wishes to do first-class work to compete with the Contractor who cares nothing for his future standing and reputation.

Estimate vs. Bid

In submitting estimates, the Engineer should know that they are reasonable and that the work can be done for the amount of his estimate. The writer has found by experience that in the majority of cases the Engineer's estimates have been too small for the work contemplated, and that the contract could not be let because the amount of bonds voted was only about two-thirds of the money needed to do the work required, and the work had to be dropped altogether or reduced to fit the bond issue. This usually causes dissatisfaction among residents and taxpayers, trouble for the city council and loss of faith in the Engineer. If the estimates are higher than the bids received, the city council and the citizens are pleased, and instead of diminishing the work, which creates dissension and a damage to the plant, it can be completed, or even extended, which may help to satisfy some of the discontented citizens.

Before bids are sought the Engineer should see that the plans are properly prepared, so that the city council may know just what is to be done and how the work is to be paid for. Contractors should not be expected to bid on work and put up certified checks and agree to give a bond and sign contracts until they know the class of payments that are to be received and know that the payments will be made as called for in the contract and specifications. They should not be asked to go to the expense of attending lettings unless the city council knows that it can let the contract if bids are satisfactory.

When asking for bids the Contractor should be required to deposit with his bid

a certified check as a guarantee that he will enter into a contract if the work is awarded to him. The certified check should be for a lump sum, so that he will know before leaving home the amount of check necessary.

The Engineer should prepare proposal blanks for the bidders so that all bids will be made on the same basis. The proposal blanks should call for a lump-sum bid and also for additions and deductions, so that the city may have the right to increase or decrease the amount of the contract. These proposal blanks, as well as the contract, should be made as short as possible. There is no reason for repeating specifications in the bidding blank and in the contract. The bidding blank and the contract should both refer to the specifications, and the specifications should cover everything necessary. One or two pages should be sufficient for the bidding blank or contract, and the specifications on the ordinary job should not cover more than 15 to 20 pages.

The Contractor's Bond

The bond should require sureties satisfactory to the city council and should not state that it is necessary to furnish a surety bond, for in a good many cases a personal bond can be furnished which will save the city considerable money and will be more desirable than a surety bond. The present rate on bonds is 1½ per cent. In many cases this is only a waste of money, as the Contractor is personally liable, and his own guarantee is sufficient to cover all the work that he has under consideration. If he is able to secure good and reliable personal bonds he should be allowed to do so; not only this, but by having the clause in this form the reliable Contractor may be able to secure a surety bond if he so wishes at a better rate than at present.

In giving progress estimates, the percentage should be as high as possible, and the Contractor should receive not less than 85 or 90 per cent payment on the amount of material furnished and the work completed the first of each month. There is no reason why more than 10 or 15 per cent should be kept back, as almost all contracts are guaranteed by a bond equal to the amount of the contract, and with this bond why should it be necessary to hold back an exorbitant amount on the payment of the work? Such action only curtails the amount of work the Contractor is able to handle, makes it necessary for him to borrow more money, on which he has to pay interest, and eventually the payment has to be made by the city.

Until three years ago the author of this article, in bidding on work, never figured anything in for the cost of his bond—employers' or public liability—but the rates have become so high in the last few years that if a Contractor failed to add these three items to his bid he would soon be put out of business. As stated before, it costs the Contractor 1½ per cent for the surety bond. It costs him from 2 to 2½ per cent for public liability, and from 4 to 10 per cent for employers' liability, so that it is evident the Contractor must add 1½ per cent on the total contract, and not less than 10 to 12 per cent on his pay-roll to cover these contingencies alone.

Burdensome Specifications

The following are a few clauses frequently found in specifications that make contracting very uncertain. Where these specifications are found it is necessary for the Contractors to increase their bids:

Clause 1:

"The contract price as above set forth shall be the whole compensation when paid to first party by second party for the laying and construction of said work as set forth in the said resolutions, plans, profiles, specifications and proposal made by the first party; whether or not there be as much, or more, or less, labor, material, excavation or rock cut or otherwise than is estimated by the City Engineer has no bearing on the above contract price and does not affect it."

Clause 2:

"The Contractor assumes all risk of variance in any computation or statement of amounts or quantities necessary to complete the work required by this contract, by whomsoever made, and agrees to furnish all labor and material of every description and to fully complete the said work in accordance with the plans and specifications and to the satisfaction of the Common Council for the price bid."

Clause 3:

"The plans and specifications are intended as complete but should anything be omitted accidentally from the specifications which is necessary to complete the work in accordance with the apparent intention of the Engineer, it will be supplied by the Contractor at no extra cost to the city."

Clause 4:

"All work not herein or on the plans specifically specified, but which may be fairly im-

plied or understood as included in this contract, and any apparatus or appliances essential to the proper and convenient operation of the plant shall be supplied and installed without extra charge by the Contractor, and the Engineer or his authorized agent shall be the judge of this."

Clause 5:

"Any discrepancies in the plans and specifications shall be decided by using the best class of work or material which any interpretation would admit of."

Clause 6:

"No claim for extra work or material shall be made or will be allowed except where ordered in writing, and all such shall be presented monthly in writing within fifteen days after the completion of said work."

Clause 7:

"Should any disagreement arise as to the true meaning of the drawings and specifications in any part, the decision of the engineer shall be final and conclusive."

According to legal advice received by the author, a Contractor has the right to bid on the least quantities stated in the contract and specifications, and Contractors are entitled to rescind a contract with the municipality for the construction of contract work where the contract was made under a mutual mistake, according to the Massachusetts Supreme Court decision, stating that:

"The estimates on which the Contractors made their bid, made by an Engineer employed by the muncipality and given to the Contractors by it as correct, materially underestimated the amount of work to be done, and it was held that the Contractor was not bound by them, notwithstanding the estimates were given in good faith, their inaccuracy unknown until after the Contractors had begun work, and notwithstanding the Contractors expressly covenanted to do the work in strict accordance with the maps, drawing, profiles, and specifications prepared therefor, all of which were to be considered part of the contract and to be construed therewith, and that the amounts and quantities of materials and work as stated in the notice to bidders, governing the making of proposals, were approximate only."

Clause 8:

"No work will be allowed to be laid in water, and all work must be kept free from water until cement is set."

Clause 9:

"The Contractor shall, at his own expense, pump, or otherwise remove, any water which may exist in the trenches, and shall form all dams or other work necessary to keep excavation clean of water during the progress of the work."

Clause 10:

"In no case shall the sewers be used as drains for water, and the end of the sewer pipe shall be kept properly plugged during construction."

In place of the above, would it not be better to state that where water is encountered it will be allowed to drain off through the sewers, as they are being constructed under the direction and approval of the Engineer, and that upon completion of the work the Contractor must see that all sewers are clean and in good order? I have known of cases where it would be impossible to construct sewers unless the water was allowed to run through them as they were laid. In general, if the Contractor undertakes to pump the water out of the sewer ahead of the sewer pipe, he only disturbs the original foundation, and is more liable to leave a place where there would be a settlement of the sewer than if the water was allowed to run through the sewer pipe.

Clause 11:

"Although the Engineer may specify certain methods for constructing work in difficult cases, this will not relieve the Contractor of the responsibility."

If the Engineer instructs the Contractor how to do work, and the specifications require that he follow the direction of the Engineer, why should not this relieve the Contractor of the responsibility?

Clause 12:

"Where the material at the grade line appears not suitable for securing a firm and unyielding bearing, in the opinion of the Engineer, the Contractor shall excavate to such depth as he may be ordered to do below the pipe line and replace the excavated material with sand, gravel, timber or concrete; timber or concrete if used will be paid for extra.

Why should the Contractor not be paid for the sand or gravel as well as timber or concrete if used? In certain cases the writer has been required to furnish sand and gravel under this clause for which he received no pay; the proper thing to use was concrete, but it would have been necessary to pay him for the use of concrete, so he was required to use gravel.

Clause 14:

"Through marshy ground the excavation shall be carried at least one foot below the grade line, and lower if required in the opinion of the Engineer, and filled with sand and gravel."

If this is done, why should not the Contractor be allowed an extra, as it is an unforeseen item?

Clause 15:

"No bill will be allowed for material left over on account of any of the above quantities being reduced during the progress of the work, nor will any extra be allowed for, or on account of, any increase in the above quantities."

If a Contractor is required to sign a contract for a certain quantity of material and the material is left over, why should not the city be allowed to pay for this material? On the other hand, if after a Contractor has been awarded a contract and has ordered his material the city makes additions and extensions, why should the Contractor not receive an amount sufficient to make up for any additional costs in securing this material?

Clause 16:

"Where pipes are being laid, the Contractor shall leave uncovered from 20 to 50 feet of pipe so that the Engineer may be able to inspect and test the grades and lines before any backfilling is permissible."

The writer has found from experience that it is advisable to fill immediately over the pipe before the cement has set. He has been called on to inspect several jobs where there has been a lot of pipe cracked or broken after the construction of the sewers, and the reason for this was that the pipes were laid and left uncovered until the cement had set in the joints, which made one continuous line of pipe and allowed no play in the joints, so that when the trench was filled after the cement had set there was no chance for any give on the line of the sewer as the backfilling was being put in place.

Clause 17:

"The successful bidder must sign the contract for the work to be done by him within ten days after the contract is awarded to him, and must begin work at any time fixed by the Engineer for him to begin, after ten days from the execution of the contract. He shall proceed with the work, prosecuting it with due diligence at such time and in such places and with such force as the Engineer may direct during the progress of the work, and he must complete the work at or before the time fixed for its completion. Should the work under this agreement not be finished within the time specified, the Contractor shall forfeit the sum of $25 per day for each and every day that shall lapse after the date fixed for completion."

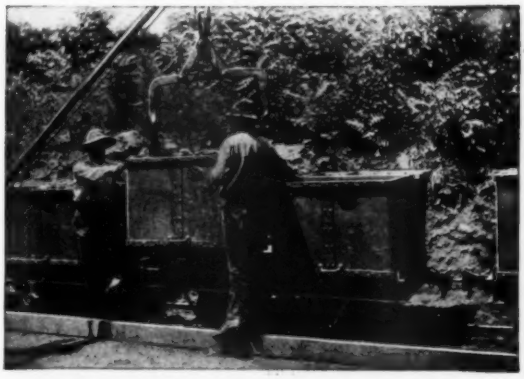
You can see that when one or more of the above clauses are put in specifications it is a difficult matter and practically impossible for a Contractor to figure or bid intelligently on the work, for it becomes a guess instead of figuring, and he can tell only what he is going to have to do when the work is completed. The only way he can come to a basis for a bid is to add a percentage for risks which would be sure to cover the unforeseen obstructions. The Engineer cannot expect to get close bids with such specifications, and not only that, it bothers the Contractor when he comes to secure bonds for the work, and makes the bond cost more.

There are generally enough risks to run on this kind of work without putting in additional ones that can as well be covered by percentage clauses. It is also asking considerable of a Contractor to sign a contract with a large forfeiture clause in case he is not able to complete the work at a certain date, when the quotations he receives on material are headed as follows: "All agreements contingent upon strikes, accidents or other causes beyond control." Would it not be well to insert this same clause in the specifications and eliminate as far as possible all uncertain clauses? The Contractor would then be able to make a close and intelligent bid on the work and have the uncertain quantity covered by a special clause giving cost plus a reasonable percentage for the use of tools and profits.

As stated before, a city council desires and should have first-class work and material, and a Contractor should see that he gets a price sufficient to do his work in the best possible manner and furnish good material, not slighting his work in any particular; he should do work that he can point to with pride and that will act as a recommendation for his ability and honesty. He should not criticize the plans and specifications at the time of the making of bids. If there are objectionable clauses he should refer to them in his proposal, and when doing the work should try to get along with the Engineer and the city council in the most agreeable manner. He should find out, before he bids, anything in the plans and specifications that he does not understand, and when he commences the work he should be ready and willing to work in harmony with the Engineer and to give the city the best possible service for the money.

The Direct or Batch Charging System for Concrete Road Work

IN the construction of a central loading plant on concrete road jobs, a combination of the principles of the bin and stock pile tunnel types was recently used in a job where Easton Industrial Railway Equipment, manufactured by the Easton Car Construction Company, Easton, Pa., was used. In this particular installation advantage was taken of a side hill, the storage bins consisting of a platform built out from the level of the siding track, overhanging the slope and supported by a timber framework. Retaining walls were provided on three sides of the platform to complete the structure. Sand and stone are unloaded and piled by means of a locomotive crane operating a clam-shell bucket, and the material is delivered to the batch cars by means of steel chutes equipped with radial gates.



A BATCH BUCKET BEING RETURNED TO ITS POSITION ON THE BATCH CAR
The next operation is to attach the lifting bale to the adjacent full bucket

Under other conditions, stock piles over tunnels, both surface and subsurface, elevated bins and portable bins with either locomotive cranes or derricks for unloading have been used to good advantage.

The cement shed or bin is usually located adjacent to the sand and stone bins. In the event that bagged cement is used, a shed is constructed with a platform extending back to the railroad siding, and the bags are handled either by a gravity roller conveyor or by hand. When bulk cement is used, the gravity bin is constructed to span the industrial track, with water-tight hatches in the roof or else a detachable roof which can be lifted off and on by crane.

The experience of the past season indicates that with careful planning of handling appliances the use of bulk cement is entirely practicable in highway construction, with a considerable saving to the contractor.

At the central loading plant the batch cars are charged with sand and stone in the correct proportions by means of chutes or traps, and are then moved along to the cement shed or bin, where the correct charge of cement is added. The spotting and assembling of cars is done by means of a gasoline locomotive, a hoisting engine, or by hand, depending on the local conditions.

A BATCH BUCKET IS HERE SHOWN DISCHARGING ITS CONTENTS INTO THE MIXER SKIP
Spotting is being done by a gasoline locomotive

Easton batch cars for carrying the batch buckets from the loading plant to the mixer are of a particularly strong, sturdy construction throughout, and especially designed to meet the exacting requirements of highway construction service. These cars are supplied with spring draw-bars to permit easy operation in long trains, with spring pedestal bearings to absorb road shock and prevent derailments, and with roller bearings and extra heavy 14-inch wheels to permit the hauling of heavy loads with minimum tractive effort. Positive-acting brakes are furnished as desired by the contractor. When the buckets are removed, the batch car may be used

as an ordinary platform car to carry track, forms, etc. Where the conditions are such that a lighter batch car is desired, a standard road car can be supplied which combines sturdy construction with light weight at a correspondingly lower cost. It must be borne in mind, however, that one of the lessons of the past season's road work is the absolute necessity for using equipment of sufficient weight and strength to endure hard service without failure of any part. The highly developed coördination of the various items of plant, which is the fundamental idea of the large-plant direct-charging method, throws the responsibility for continuous production on the individual unit. In certain operations, if one unit fails, the entire work stops, with a corresponding loss in time and money to the contractor.

Easton batch buckets and boxes for mounting on the batch cars are likewise specially designed for road-building service. The buckets are made of steel plate with heavy reinforcing angles and bars, to give a unit which is practically indestructible and easily operated. These buckets are ordinarily furnished with separate compartments for sand, stone and cement, insuring a correctly proportioned batch, a water-tight cover being supplied for the cement compartment. The buckets, however, are furnished without partitions when desired by the contractor, in which event the materials may be proportioned by the use of marks on the side plate of the bucket, or by measuring hoppers in the bins.

After the batch cars have been loaded and assembled at the central loading plant, they are hauled to the mixer by a gasoline or steam locomotive (shown in the illustration) over portable tracks laid on the shoulder of the road wherever possible. By hauling the material in this manner, operation becomes independent of weather conditions, and the finished grade is not cut up, with the resulting necessity of a second grading, as is the case when trucks or teams are used. The road builder can start on the short haul just as soon as a part of the grade is finished, and when the long haul is finally reached, the track is firmly imbedded, permitting higher speed service than is possible over newly laid track.

Upon the arrival of the industrial car at the mixer, the batch buckets or boxes are swung over the mixer skip or hopper by means of an adjustable derrick attached to the mixer or a separately propelled crane, and the contents are discharged, by tipping in the case of the buckets, and by releasing bottom doors in the case of the boxes.

Railroad Construction and Shipping Afford Large Field for Motor Trucks

THAT the railroads of the country will eventually furnish one of the greatest markets for motor trucks is the prediction of C. B. Stanley, Manager of the Research Bureau of The Four Wheel Drive Auto Company, Clintonville, Wis. This opinion is based on the fact that the motor truck established itself as an economical transportation auxiliary to the railroads during the pressure of war-time haulage, and that with the return of the roads to private ownership, and the restoration of the old-time competitive spirit, this economical phase of transportation will be keenly developed by the railroads.

"The return of the railroads to private ownership means that each road will avail itself of every possible means of increasing its transportation efficiency," says Mr. Stanley. "During the war the motor truck proved its value in giving relief to the overburdened railroads in a way that demonstrated that it could be used to transport goods speedily, safely and economically. For short hauls, it was apparent that the truck was faster, safer and more economical, all of which added to the popularity of the 'Ship by Truck' method, and caused an increased demand for trucking.

"With the unusual demands over, however, and the return of the railroads to private ownership, it is to be expected that each road will be out getting all the business it can. They will look with jealous eye upon any attempt to divert the traffic of the country to new channels, with the result that rather than see competitive trucking service increase and a disposition on the part of truck owners to enlarge this service, the railroads will themselves inaugurate fleets of motor trucks to facilitate their transportation.

"The advantages of a motor truck transportation system for short hauls to facilitate the work of the steam roads are numerous. Probably the most striking is their economical feature. There is no expense for the right of way, and the cost of upkeep is centered entirely in the truck. There is no uncertainty about the terminal charges and no necessity for warehouses. Moreover, the truck has the advantage of being able to go in any direction without being forced to follow a definite line of rails.

"The concerted action of federal and state commissions to improve the nation's roads and highways is an added inducement that promises to increasingly popularize the 'Ship by Truck' method of transportation."

Overloading Dump Trucks is Poor Business

By F. L. Henk

Managing Secretary, Detroit Transportation Association

THE march of progress of all great cities brings with it intensive activity in the erection of gigantic buildings necessary to house the increasing industrial growth. It is in the erection of such buildings that the motor truck plays an important part, particularly during the initial building stage—the excavating.

THE SIDE DUMP, ONE OF THE MOST USEFUL ALLIES OF THE CONTRACTOR

Dump motor trucks have been used in excavating work since 1914. Probably one of the first jobs on which dump trucks went into an excavation and brought out their loads was the excavation of 700 feet of tunnel in New York City, from Park Place to Mulberry Street. The excavating contracting firm of Holbrook, Cabot & Rollins handled the job. This work was done during the summer of 1914. Since that time the dump truck has been perfected to its present high state of efficiency.

The use of the dump motor truck has effected much economy in excavating work, but there is one phase which has developed in the use of these trucks which threatens to do a lasting harm to the industry of dump-truck hauling and inflict a severe wound on the motor-truck industry in general, and that is the evil of overloading.

ANOTHER VIEW OF THIS EQUIPMENT, SHOWING IT AFTER RELEASE

Principal Danger in Winter

There is not much danger of this evil during the summer months, as there is usually plenty of work for the dump truck, but during the winter months, taking advantage of the slack conditions, some so-called "excavating contractors" have seized the opportunity of placing immense overloads on dump trucks in their em-

THIS PICTURE ILLUSTRATES WHAT A CARELESS DRIVER CAN DO

ploy. The dump trucks which the excavating contractor claims he is operating are usually trucks which belong to individual owners, who are purchasing them on a time basis, the trucks being bought on a down-payment of 25 per cent, with the balance payable in twelve months. With the present high cost of motor trucks, the monthly payments are, of course, high. It is at this point that the individual operator is coerced into working his truck overloaded. He sees the business of excavating dropping off, and, fearful of his obligations to the truck dealers, he sells his services to the excavating contractor at a rate which is below the actual operating costs of his truck, and permits the truck to be overloaded, little dreaming of the disaster which awaits him.

"Overloading," to quote from a leaflet addressed to motor-truck operators by the Pierce-Arrow Motor Car Company, "increases the stresses in the weight-carrying members and may cause excessive breakage of these parts. In any good truck, normal weight, hence normal stress, produces normal wear of moving parts. An excess will necessarily result in abnormal or excessive wear. A truck frame and other parts may be compared to a bridge. When a bridge is rated at so many tons, it means that it can carry that load with a certain margin of safety. It will carry more, but the margin of safety which was provided to take care of its depreciation in normal service will not be as large. The same is true of a truck."

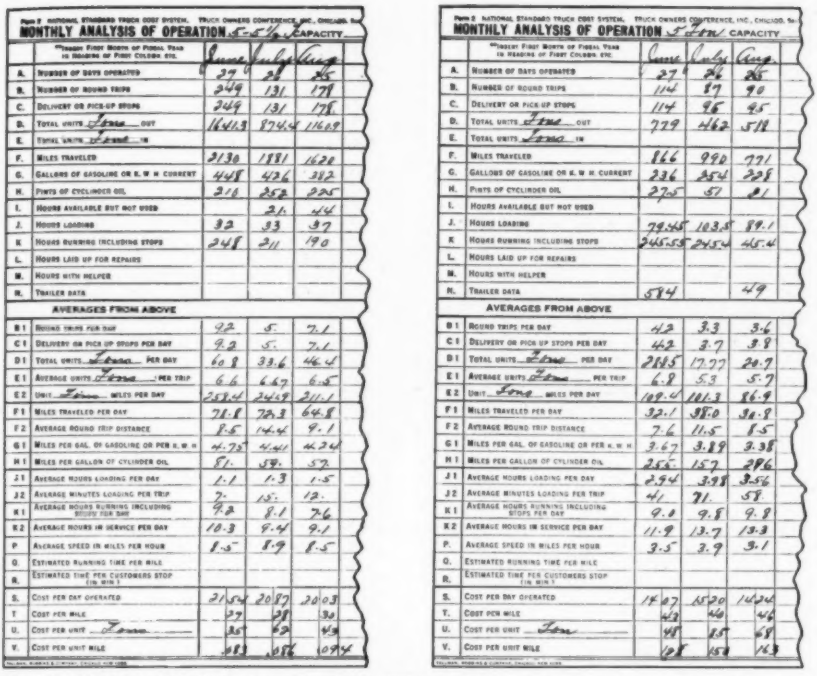
To quote further from this same leaflet: "Overloading decreases the ability of the truck to negotiate road conditions, since there is a greater weight to be moved per unit of engine power. A result is excessive gasoline consumption and slower operating speed, therefore greatly reduced efficiency."

"An Offense Against Business"

That other truck manufacturers agree on this point is proved by the following quotations from a treatise on overloading prepared by the Packard Motor Car Company:

"Overloading is a most disastrous abuse to a motor truck. Truck abuse, whether it be overloading or anything else, is a grievous offense against business, because it blocks the progress of transportation. Transportation is the life-blood of business. Million of tons of freight are accumulating in this country every day. The task of moving it is too great for the railroads, even in their own sphere. A system

THE TRUCK SHOULD BE AT THE RIGHT PLACE TO TAKE ON A LOAD



Form 2 NATIONAL STANDARD TRUCK COST SYSTEM. TRUCK OWNERS CONFERENCE, INC., CHICAGO, Ill.

MONTHLY ANALYSIS OF OPERATION 5-5½ CAPACITY

	"Insert First Month of Fiscal Year in Heading of First Column etc.	June	July	Aug.
A.	Number of days operated	27	28	25
B.	Number of round trips	249	131	179
C.	Delivery or pick-up stops	249	131	178
D.	Total units Tons out	1641.3	874.4	1160.9
E.	Total units Tons in			
F.	Miles traveled	2130	1881	1620
G.	Gallons of gasoline or K. W. H. current	448	426	382
H.	Pints of cylinder oil	216	252	225
I.	Hours available but not used		21.	44
J.	Hours loading	32	33	37
K	Hours running including stops	248	211	190
L.	Hours laid up for repairs			
M.	Hours with helper			
N.	Trailer data			
	AVERAGES FROM ABOVE			
B1	Round trips per day	9.2	5.	7.1
C1	Delivery or pick up stops per day	9.2	5.	7.1
D1	Total units Tons per day	60.8	33.6	46.4
E1	Average units Tons per trip	6.6	6.67	6.5
E2	Unit Tons miles per day	253.4	249.9	211.1
F1	Miles traveled per day	78.8	72.3	64.8
F2	Average round trip distance	8.5	14.4	9.1
G1	Miles per gal. of gasoline or per K. W. H.	4.75	4.41	4.24
H1	Miles per gallon of cylinder oil	51.	58.	57.
J1	Average hours loading per day	1.1	1.3	1.5
J2	Average minutes loading per trip	7.	15.	12.
K1	Average hours running including stops per day	9.2	8.1	7.6
K2	Average hours in service per day	10.3	9.4	9.1
P	Average speed in miles per hour	8.5	8.9	8.5
Q.	Estimated running time per mile			
R.	Estimated time per customers stop (in min.)			
S.	Cost per day operated	21.54	20.87	20.03
T	Cost per mile	2.7	2.8	3.0
U.	Cost per unit Tons	2.5	2.3	2.3
V.	Cost per unit mile	2.3	2.38	1.094

Form 2 NATIONAL STANDARD TRUCK COST SYSTEM. TRUCK OWNERS CONFERENCE, INC., CHICAGO, Ill.

MONTHLY ANALYSIS OF OPERATION 5 Tons CAPACITY

	"Insert First Month of Fiscal Year in Heading of First Column etc.	June	July	Aug.
A.	Number of days operated	27	26	25
B.	Number of round trips	114	87	90
C.	Delivery or pick-up stops	114	96	95
D.	Total units Tons out	729	462	518
E.	Total units Tons in			
F.	Miles traveled	866	990	771
G.	Gallons of gasoline or K. W. H. current	236	254	228
H.	Pints of cylinder oil	275	51	81
I.	Hours available but not used			
J.	Hours loading	79.45	103.5	89.1
K	Hours running including stops	245.55	245.4	245.4
L.	Hours laid up for repairs			
M.	Hours with helper			
N.	Trailer data	584		49
	AVERAGES FROM ABOVE			
B1	Round trips per day	4.2	3.3	3.6
C1	Delivery or pick up stops per day	4.2	3.7	3.8
D1	Total units Tons per day	28.85	17.77	20.7
E1	Average units Tons per trip	6.8	5.3	5.7
E2	Unit Tons miles per day	169.4	181.3	86.9
F1	Miles traveled per day	32.1	38.0	30.8
F2	Average round trip distance	7.6	11.5	8.5
G1	Miles per gal. of gasoline or per K. W. H.	3.67	3.89	3.38
H1	Miles per gallon of cylinder oil	25.5	157	29.6
J1	Average hours loading per day	2.94	3.98	3.56
J2	Average minutes loading per trip	41	71	58
K1	Average hours running including stops per day	9.0	9.8	9.8
K2	Average hours in service per day	11.9	13.7	13.3
P	Average speed in miles per hour	3.5	3.9	3.1
Q.	Estimated running time per mile			
R.	Estimated time per customers stop (in min.)			
S.	Cost per day operated	14.07	15.20	14.24
T.	Cost per mile	4.2	4.0	4.6
U.	Cost per unit Tons	4.8	8.5	6.8
V.	Cost per unit mile	1.8	1.58	1.43

THE NATIONAL STANDARD TRUCK COST SYSTEM USED CAREFULLY WILL SHOW ANY CONTRACTOR JUST WHAT HIS TRUCK IS DOING

of motor truck transportation is needed to help the railroads. Intensive transportation that can be supplied only by motor trucks is absolutely necessary to permit further industrial development in this country. It is the duty of business to see that it does nothing that interferes with the development of this transportation system."

Narrowing this subject down to the field of the building contractor and the hauling contractor, it is clear that they both, as business men, have a duty toward this new transportation system.

If the building contractor insists on overloading the trucks on his job, the axles, tires, wheels, springs, frames, brakes, transmission and engines of those trucks are going to be prematurely worn out and extremely expensive to maintain before they finally do come to an untimely end.

In order to make a success of the system of motor-truck transportation it is necessary for the trucks to be making a profit for their owners. The owners must be in a position from the start to know whether their trucks are making or losing money. An overloaded truck is never making a true profit. What it earns temporarily by hauling overloads it will lose in repairing and replacing the parts worn out by the strain. It will have to be relegated to the scrap heap before its time, leaving nothing but a trail of waste in its wake.

The Detroit Transportation Association, as representing 260 commercial hauling concerns in Detroit, wishes to place itself on record as unalterably opposed to the overloading of dump motor trucks. We believe that with the present state of curtailed production in all lines of work, the conservation policy in effect during the war should be continued until such time as conditions are again normal. At present, motor truck production is not up to the demand, and the premature wearing out of dump motor trucks, with the attendant slowing-up of excavation work brought about through breakdowns, etc., is a serious question which we believe is blocking the proper development of the motor truck in

one of its most important spheres—excavating.

Not only does overloading ruin the individual operator of the truck who persists in it, but it also hurts the motor truck industry at large by engendering a feeling of distrust in the mind of the truck operator as to the real merits of the motor truck he owns—and overloads. Premature wearing out of parts leads him to believe that the truck is of faulty construction, and he does not think to blame the overloading.

Railroads are very careful not to overload rolling stock. They know of the dangers of such methods. Bad freight-train wrecks taught them that overloading railroad cars was a poor-paying proposition. Brakes on an overloaded vehicle do not work properly. An overloaded dump truck running through city streets is a menace to the public. A truck of large capacity, fully loaded, requires a maximum of skill and power to bring it to a quick stop, as is often necessary in our ever-increasing congestion of traffic. If a truck is overloaded, the operation is made doubly hard, and the brake mechanism is called on to perform a task for which it is not built.

Summing up all these points, it is easily seen that overloading dump trucks is mighty poor business, and the excavating contractor who persists in overloading is traveling on very unfirm ground.

This article deals principally with dump trucks, with which the overloading evil has been the most prominent. The results of overloading, however, are the same regardless of type of body, and the wise truck owner who has his own best interest at heart is the one who recognizes a truck's limitations.

The purchase of a truck, whether by corporation or individual, represents an investment intended to be profitable and to give long, continuous service to its owner.

To satisfactorily perform the service for which a truck is intended, its owner must recognize that the responsibility for such satisfactory service rests almost wholly with him.

Don't Be the Goat

Don't be the goat for the excavation contractor by allowing him to overload your truck and jam it to pieces with a steam shovel without recompense. When operating teams you would quickly call a halt under such conditions. It's just as disastrous to overload your truck.

Before going on to a job have an understanding as to maximum load to be hauled, the remuneration for it and the contractor's liability for damage done by the steam shovel. If you and every other truck owner going on to a job would get together on these points you could curb this overloading abuse and form of robbery which actually takes money out of your pocket and puts your truck on the junk pile in a year, when you should get not less

THE PORTABLE CRANE SAVES TIME IN HANDLING HEAVY MATERIAL

than five years' profitable service out of it. Now, when the demand for trucks greatly exceeds the supply, is the time for truck owners to correct these evils.

Don't overload, don't overspeed, drive carefully over rough roads, see that your truck is well lubricated and adjustments made when necessary, and your truck purchase will prove to be a most profitable investment.

EDITORAL NOTE.—The illustrations for this article were furnished through the courtesy of the Packard Motor Car Company, Detroit, Mich.

HEAVY PLANKING UNDER THE TRUCK SAVES TIME AND MONEY

A Stupendous Piece of Concrete Construction

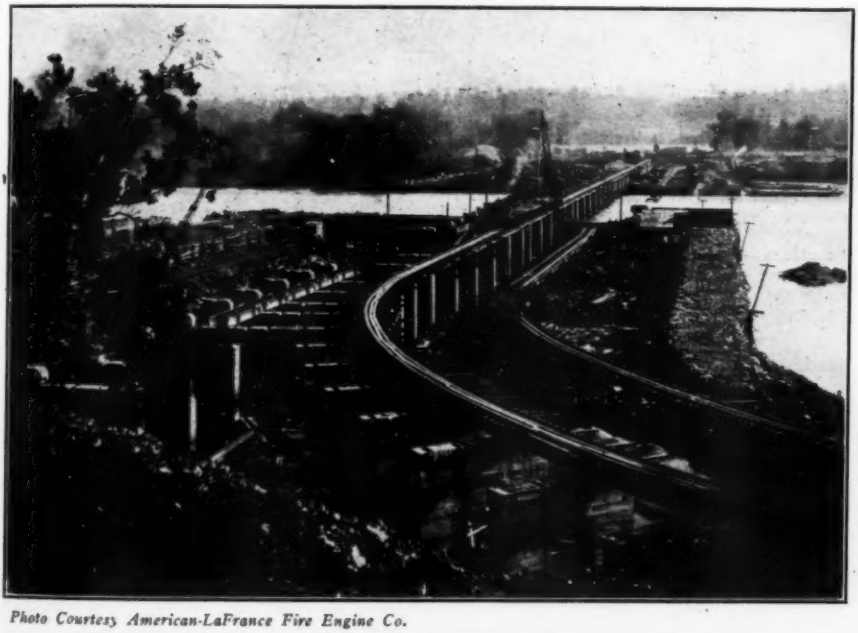


Photo Courtesy American-LaFrance Fire Engine Co.

THE WILSON DAM IN THE TENNESSEE RIVER, NEAR MUSCLE SHOALS, ALA.

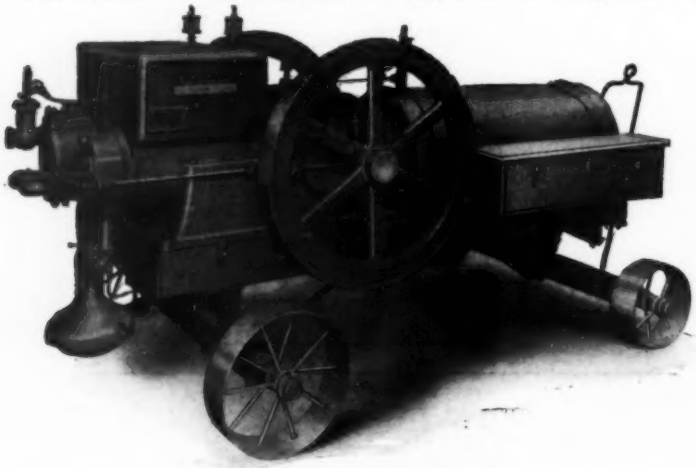
The Wilson Dam is being constructed by the Engineering Department of the United States Army, and when completed it will be the largest power dam in the United States. It will be about 4,000 feet long and 96 feet high.

A well-organized fire department has been established to protect the enormous plant of the U. S. Air Nitrates Corporation at Muscle Shoals and the great number of houses used by the employes at this plant, and to protect the camp which houses a large part of the force working on the dam.

A Compact and Effective Compressed Air Outfit

THE contractor who is using pneumatic hammers or drills on a job does not want to be bothered with a semi-permanent compressed air installation which can be moved only at long intervals, thus necessitating the use of lengthy compressed air lines with the attendant losses. As a means of overcoming this difficult and uneconomic proposition, Chris D. Schramm & Son, Inc., Philadelphia, Pa., has placed on the market a portable compressed air outfit of its own manufacture. This outfit, illustrated herewith, consists of a standard 4-cycle, horizontal, water-cooled gas engine, developing 9 to 11 horse-power on 5 to 12 gallons of fuel per day. The total weight of the machine, including both engine and air compressor, is 3,100 pounds, and the operating speed is from 300 to 400 revolutions per minute.

This is a machine which is now being used by many contractors with great satisfaction because it can be readily drawn to the most convenient point for operation and removed when blasting is necesary after drilling, or edged along to the next place where riveting is under way. It minimizes the necessary capital investment in compressed air hose or pipe line, and with its standard, sturdy construction is a dependable ally for any contractor using compressed air.



PORTABLE AIR COMPRESSOR WITH MANY ECONOMICAL FEATURES

General Marshall Appointed Manager of the Associated General Contractors

GENERAL R. C. MARSHALL, JR., recently Chief of the Construction Division of the U. S. Army, has been appointed General Manager of the Associated General Contractors of America by the Executive Board. The *Bulletin* of the association makes the following comments:

"The selection of General Marshall marks the beginning of the active campaign to carry through the program which has been developing during the past year of preliminary work. Besides the direction of the work of the sixteen committees, this program includes the development of the Publication and Information Service, the Contractors' Service Corporation, the Legislative Service, and other service bureaus of the association, and the several members' divisions, including the Building Contractors' Division, the Public Works Contractors Division, the Highway Contractors' Division and the Railroad Contractors' Division—many of which have been organized in charge of different members of the staff during the past year.

"The rapid growth of the association from a membership of 97 construction firms representing a few centers, to 700 construction firms representing 36 States and 150 cities throughout the country, and the position of leadership which the association has been asked to take on questions of national importance relating to legislation, construction development, labor, materials, transportation, methods, trade practices, etc., as a result of the work which has already been done, offer to General Marshall a field of activity commensurate with the ability which he has shown as Chief of the Construction Division of the Army."

WHAT YOU WANT WHEN YOU WANT IT!

The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

PAVING PLANTS AND MACHINERY.
Combination stationary, portable and semi-portable asphalt plants for manufacturing material for surfacing asphalt roads or for the making of binder mixtures or bituminous macadam, are described in a series of bulletins published by Hetherington and Berner, Indianapolis, Ind. The plants are capable of furnishing up to 2,000 yards of finished pavement per day with a 2-inch topping and 1-inch binder, or 3,000 yards of 2-inch topping only.

"CATERPILLAR" TRACTORS FOR HEAVY HAULING.
"Tractor Performance," published by the Holt Manufacturing Company, Peoria, Ill., discusses extensively the use of "Caterpillar" tractors in industries, agriculture and contracting. The booklet is well illustrated with instances of great service rendered by the Holt tractor and will be found to be of value to the prospective purchaser of either heavy or light tractors for hauling.

HOW DO YOU UNWATER TRENCHES?
Bulletin No. 19-D, a practical and compact treatise on semi-portable and portable diaphragm pumping units with direct-connected, four-cycle, water-cooled, gasoline motor, is published by the Domestic Engine and Pump Company, Shippensburg, Pa., and may be secured for the asking by contractors and others interested in diaphragm pumping equipment.

ROAD CONSTRUCTION EQUIPMENT.
The Koppel Industrial Car and Equipment Co., Koppel, Pa., publishes a 47-page reference book, called Catalog No. 100, which is an excellent guide to modern and efficient hauling in the construction of good roads. It contains illustrations showing the value and use of Koppel equipment in various parts of concrete road construction, with diagrams of typical layouts for concrete plants and details of industrial railway tracks, trucks, concrete batch boxes, dump cars, and flat cars, and many pages of useful information and definitions of great value to the contractor or engineer in furnishing estimates.

NON-LEAKABLE ROAD TAR AND ASPHALT KETTLES.
Connery & Company, Inc., 4000 North Second Street, Philadelphia, Pa., have a set of specifications in loose-leaf form, covering their non-leakable welded road tar and asphalt kettles with double burner outfits using kerosene or coal oil, and the complete line of sand dryers, which will be of great interest to the contractor or road engineer who contemplates the purchase of new equipment of this general type.

WATER-WORKS TOOLS AND SUPPLIES.
The A. P. Smith Manufacturing Company, East Orange, N. J., manufacturer of special patented water-works tools and supplies, issues a series of bulletins covering such valuable machinery as corporation tapping machines, valve inserting machines, pipe cutters, valves, devices for filling sprinkling wagons for street flushing purposes, pipe melting furnaces, hydrants, removable plugs, etc.

CABLES FOR PORTABLE TOOLS AND LIGHTS.
If you are looking for a cable as flexible as a light cord, yet so protected that it will stand hard usage, for portable electric tools and lights, write for a copy of descriptive circular No. 1, to the Simplex Wire and Cable Company, 210 Devonshire Street, Boston, Mass.

FREE BOOK ON ROAD ROLLERS.
Catalogue A, published by the Buffalo-Springfield Roller Company, Springfield, Ohio, contains valuable data on the construction and operation of tandem road rollers, of particular interest to construction engineers and contractors.

A SURFACE HARDENER FOR CONCRETE FLOORS.
If you are interested in securing a material which is readily washed on to the concrete floors of waterworks, fire houses, filtration plants, pumping stations, etc., to make them as hard as glass and therefore dust-proof and water-proof, write to Department 27, L. Sonneborn Sons, Inc., 264 Pearl Street, New York City, and ask for literature describing Lapidolith.

YOUR CHOICE OF CRUSHERS.
The Worthington Pump and Machinery Corporation, 115 Broadway, New York City, stands ready to furnish the quarryman, contractor and materials man with the form of crusher best suited to his particular need. If he wants a McCully Gyratory crusher, he will send for bulletin P. M. 4; if he wants a McCully crusher, he will send for P. M. 50; while if he will be better suited with a Superior jaw crusher, Bulletin P. M. 44 will give him all the information he desires.

PORTABLE BELT CONVEYORS.
What do you want to move? Whether it be ore, excavated dirt or rock, coal, refuse, gravel, crushed stone or any other such material, you will find in the literature of the Portable Machinery Company, Passaic, N. J., interesting data on its portable belt conveyors, which are used very generally for loading and rehandling material.

FRESNOS, WHEEL SCRAPERS, GRADING PLOWS, ETC.
If you are in the market for drag scrapers, wheeled scrapers, fresnos, ditch scrapers, grading plows, steel wheelbarrows, wood frame barrows or like equipment for road construction or other work, it will pay you to get in touch with The Sidney Scraper Company, Sidney, Ohio, and particularly to get a copy of Catalog No. 39, which lists this sturdy equipment.

A LIGHT-WEIGHT MIXER.
The Dandie mixer, manufactured by the Koehring Machine Company, Milwaukee, Wis., which is a light paver built for highest mixing ability and dependability, is described in an interesting illustrated pamphlet entitled "Koehring Dandie Mixer."

CONTRACTORS' MACHINERY AND EQUIPMENT.
The Dyar Supply Company, 66 Broadway, Cambridge, Mass., dealer in contractors' and municipal supplies, is ready to send you data and catalogues on wagon loaders, earth-moving machines mounted on tractors, excavators, concrete mixers, hoists and portable sand, stone and gravel heaters, as well as compressed air drilling outfits.

KOEHRING

THE exclusive Koehring features of design mean higher speed in charging, mixing, and discharging—a big extra daily yardage.

Koehring heavy-duty construction is a guarantee of ***maintained*** top-speed operation—the surest profit factor you can put on a job.

Koehring ***re-mixing*** action means dominant strength concrete—concrete that is uniform in distribution of aggregate to the last shovelful of every batch.

Write for Catalog H. D.

KOEHRING SIZES
In cu. ft. mixed concrete

Construction Mixers: 4, 7, 10, 14, 21, 28, Steam and Gasoline.

Paving Mixers: 10,14,21,28. Boom and Bucket and spout distribution, Caterpiller traction, loading derrick, steam and gasoline.

KOEHRING MACHINE CO.
MILWAUKEE WISCONSIN

A STANDARD LINE OF WHEELBARROWS.
The Kilbourne & Jacobs Manufacturing Company, Columbus, Ohio, has developed a standard line of wheelbarrows which enables the contractor to maintain a complete stock with fewer units. As this is a distinct advantage, you will be interested in securing a copy of Catalog No. 41, describing this line of wheelbarrows and scrapers.

COMPLETE DATA ON WOOD PIPE.
Complete information regarding the use of wood stave pipe and advice as to the best methods of laying continuous wood stave pipe for irrigation purposes, hydro-electric power developments, hydraulic operations, sewage disposal, drainage and other work can be secured by writing to the Western Wood Pipe Publicity Bureau, White Building, Seattle, Wash.

THOROUGHBRED HOISTING ENGINES AND LOCOMOTIVE CRANES.
Catalog No. 106, published by the American Hoist & Derrick Co., St. Paul, Minn., is a 160-page volume describing the complete line of "American" hoists, derrick engines, scraper-excavator engines, locomotive cranes, electric hoists, and steel stiff-leg derricks, and also contains a large number of illustrations of "American" products in use on large engineering works.

CONTRACTORS EQUIPMENT—WHAT DO YOU NEED?
The Dake Engine Company, Grand Haven, Mich., publishes a catalog—No. 27—with a complete listing of air motors, pneumatic hoists, contractors' equipment, marine machinery, etc., which will be of great interest and value to the engineer or contractor seeking dependable equipment of this type for new work.

BLAST HOLE MACHINES.
In an interesting series of circulars, the Loomis Machine Company, Tiffin, Ohio, describes its complete line of "Clipper" machines, used by many prominent quarry companies and stone producers throughout the country. A set of these bulletins and circulars will be sent to any interested contractor who is considering the purchase of blast hole drilling machinery.

ROAD BUILDING BY MOTOR TRUCK.
If you wish to secure data on the performance and possibilities of motor trucks, write to Ralph Kaye, Kissel Motor Car Company, Hartford, Wis., and ask for a copy of folder No. 4, on highway building.

SUPERIOR QUALITY SHOVELS AND SPADES.
The line of shovels, spades and scoops manufactured and sold by the Indiana Shovel Company, Newcastle, Ind., is one of the most complete lines available for contractors in this country. The dirt-mo ing instruments are made in plain back, hollow back, back strap and solid shank patterns. The revised price list will be of interest to you.

SELF-OPERATING ROAD LEVELERS.
The Baker Manufacturing Company, 503 Stanford Avenue, Springfield, Ill., in catalog No. 75 describes two self-operating road levelers for use with tractors, which are particularly valuable for contracting work in preparing new road surfaces.

THE DIVERSIFIED SERVICE OF CAST-IRON PIPE.
The Cast-Iron Pipe Publicity Bureau, 1 Broadway, New York City, has published a very interesting booklet, describing not only the best method of casting iron pipe, but also showing the unusual service of cast-iron pipe under a great many conditions. A copy of this booklet may be secured by writing for the "Industrial Service of Cast-Iron Pipe."

MOTOR TRUCK DUMP BODIES.
In Circular 105 G, the Heil Company, 1243 26th Avenue, Milwaukee, Wis., describes in detail the operations of its Hydro hoists, which are used extensively on highway trucks by state highway departments of the Federal Government. This circular includes an unretouched picture showing the even spread of gravel by Heil dumping equipment.

ASPHALT MAINTENANCE METHODS.
In a booklet entitled "Practical Methods Applied to Modern Paving," the Equitable Asphalt Maintenance Company, 1901 Campbell Street, Kansas City, Mo., outlines proper methods for repairing and patching asphalt streets permanently.

QUICK DUMPING SAVES MONEY.
Contractors whose aim it is to keep their trucks on the road as much as possible and eliminate lost time when dumping will be interested in the folder "Lifting 5,000 Pounds with One Hand" which describes in detail Columbian steel bodies and steel hoists, manufactured by the Columbian Steel Tank Company, 1519-1625 West 12th Street, Kansas City, Mo.

BUCKETS FOR DREDGING, DIGGING AND DITCHING.
Pamphlet 613 G, issued by the Hayward Company, 50 Church Street, New York City, contains complete descriptions and illustrations of different types of Hayward buckets for various services.

ECONOMICAL MACHINERY PURCHASES.
The contractor who needs to secure immediate shipments of machinery for work which will be started shortly sometimes cannot afford to wait for new machinery. Bulletin 285, recently published by the Walter A. Zelnicker Supply Company, St. Louis, Mo., lists a wealth of used equipment ready for shipment which will be exceedingly valuable and economical for the contractor.

HANG UP THIS PUMP AND FORGET IT.
In an interesting illustrated 40-page booklet, the Pulsometer Steam Pump Company, 220 West 42d Street, New York City, describes its steam pump, which is adapted to all operations requiring ease of installation, simplicity of operation and minimum of care, and the ability to handle semi-fluid materials. This pump may be hung up in any convenient place and operates readily with minimum attention.

PIPE THREADERS, DIE STOCKS AND REAMERS.
Contractors in need of pipe tools, including receding pipe threaders, die stocks and burring reamers, will find much of interest in catalog 42 G of the Greenfield Tap and Die Corporation, Greenfield, Mass. This booklet also gives miscellaneous tables of information, including a table of standard wrought steam, gas and water pipe, drill sizes for pipe taps, Briggs standard taper pipe thread, British standard pipe thread, wire gauge standards, copper wire tables, weights of sheet copper, etc.

THE BEST IN USED EQUIPMENT.
The bulletins of the Mid-Continent Equipment and Machinery Co., Security Building, St. Louis, Missouri, which may be secured by writing to R. H. Wilson, contain listings of new and second-hand cars, steam shovels, locomotives and machinery of particular value and interest to contractors.

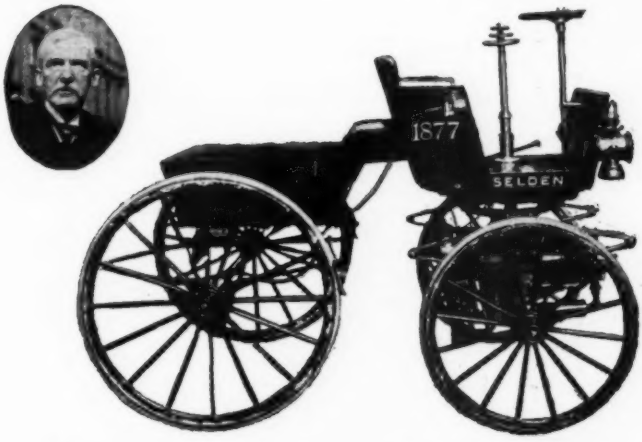
PORTABLE TAR AND GRAVEL HEATERS.
Catalog B, published by Littleford Bros., 500 East Pearl Street, Cincinnati, Ohio, contains valuable information regarding this company's portable tar and asphalt heaters, gravel dryers and heaters and pressure distributing tanks for mounting on motor trucks and wagons.

MOTOR TRUCKS TO SUIT CONTRACTORS' NEEDS.
In an interesting 8-page bulletin, the Autocar Company, Ardmore, Pa., gives a number of reasons why contractors and building supply dealers should look into the value of this truck. The names of a great many owners of Autocars in the contracting and building supply business are given.

THE IDEAL IN MOTOR TRUCK TIRES.
Contractors interested in securing a motor truck tire which will combine durability with the best resiliency should write to H. R. Hurd, Kelly-Springfield Tire Company, New York, N. Y., and ask for a copy of the latest bulletin on Kelly "Caterpillars."

MATERIAL-HANDLING MACHINERY AND STRUCTURAL STEEL WORK.
General Catalogue No. 18, published by Gifford-Wood Company, Hudson, N. Y., describes a wide variety of contractors' supplies, including crushed stone and gravel plants, car movers and pullers, belting, sheaves, wire rope, storage warehouses and a general line of elevating and conveying machinery, as well as sheet and structural steel work.

FULL-CIRCLE SWING SHOVELS AND CRANES.
Catalogue No. 11, issued by the Thew Shovel Company, Lorain, Ohio, gives a complete description of Thew steam, gasoline and electric shovels and cranes and contains many illustrations showing them on the job.



The Beginning of the World's Second Largest Industry

GEORGE B. SELDEN invented, in 1877, the first internal combustion gasoline engine for road locomotion. This was the beginning of the world's second largest industry.

History affords no more startling record of achievement than the development of the automotive industry, which resulted from this remarkable invention by Selden. Selden Trucks have shared in the development of this second largest industry. Wherever in the world there has existed a need for dependable, economical, profitable haulage of commodities, SELDEN TRUCKS have served and proved their ability. SELDEN TRUCKS possess tremendous strength of construction and enormous pulling power. Actual records of users prove their cost of operation and maintenance to be low. There are no better trucks than SELDEN TRUCKS. Ask us to give you facts that will show how Selden Trucks are effecting economies in your line of business.

1½, 2½, 3½, 5 Ton Models—All WORM Drive

WRITE for Booklet, "Yesterday, Today, Tomorrow," which contains a brief history of the early days of the automobile.

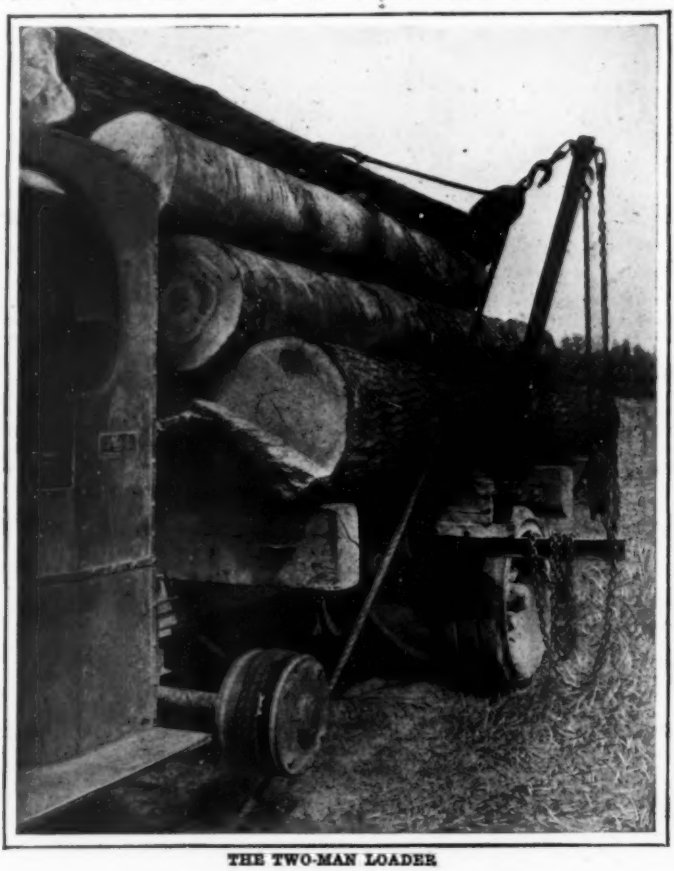
SELDEN TRUCK CORPORATION, Rochester, N. Y., U. S. A.

Selden Motor Trucks

Ingenious Two-Man Loader for Motor Trucks

two-man loader for handling
is devised by some men con-
Hoffman Brothers Lumber
rt Wayne, Ind. These men
not
ed in devising but turned into
practica
inpole and drum combination
with which t
men can load and unload timbers of tremendous size, with no specially tiring effort. With this outfit installed upon their Mack truck, they have been able to materially increase the total footage handled per day and correspondingly cut the hauling costs, but when they found that the Mack could, at a slight increase of gas consumption, haul a trailer of equal capacity, they did what many older lumber men would have termed the impossible.

The trailer is loaded first by running the truck alongside and throwing the sling rope across both chassis. After the trailer is loaded, the Mack couples to it and travels to the next loading point, where the truck proceeds to load itself. Many heavy-haulage experts have doubted the ability of the motor truck to plow its way into heavy ground such as virgin forest and supersede the horse and locomotive even to a small degree. However, the motor truck of to-day has demonstrated its ability to withstand racking strain and shocks which are more severe than could have been withstood by the motor trucks of a few years ago. The truck that stands up under such hard usage for a period of years must have safety factors and quality built into it from the rear axle, through the transmission clutch and engine, to say nothing of springs and a flexible frame that can stand twists and strains under a heavy load upon bad roads.



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To show the state of work in progress.

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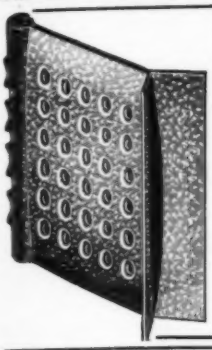

NIAGARA WALL PLUGS, (TWO SIZES)

For building into Walls of Brick, Stone or Concrete as a base for nailing.

OTHER SPECIALTIES

Galvanized Wall Ties 7½ inch; Galvanized Wall Ties 12 inches; Galvanized Veneer Ties; Steel Sash Pulleys; Steel Sash Fixtures; Steel Sash Chain; Chandelier Chain.

Samples on request. Ask for Folder 67.

NIAGARA FALLS METAL STAMPING WORKS
235 10th St., Niagara Falls, N. Y.

By a simple turn of the crank

-it does all your figure-work

A forward turn of the crank to multiply or add; a backward turn to divide or subtract—and there's your answer in the dials—proven correct by the Monroe Visible Check.

Leading public works contractors and municipal engineers are saving costly time by using the Monroe on all figure-work in connection with designs, estimates, payrolls, surveys, accounting, etc. Write for "Book of Facts."

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REG. U. S. PAT. OFF.

Calculating Machine

MONROE CALCULATING MACHINE CO.
Woolworth Building, New York, N. Y.
Offices in Principal Cities

WATROUS PATENT PLUMBING FIXTURES AND DUOJET WATER CLOSETS

Write for Catalog of the complete Watrous Line. Sent Free on request.

THE IMPERIAL BRASS MFG. CO.
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TARCO POURING POTS

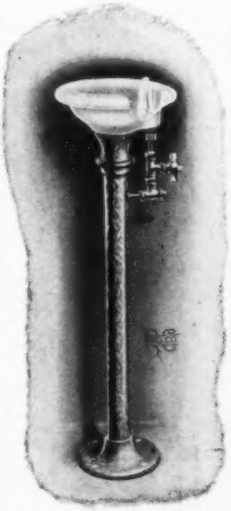
Patrolman Kettles
Street Cans
Can Carriers
Street Cleaners
Asphalt Pumps
Joint Fillers

Catalog on application

TARRANT MFG. CO.
SARATOGA SPRINGS NEW YORK

Rundle-Spence "Vertico-Slant" Overcomes All Objections

The "VERTICO-SLANT" is the very latest feature in modern drinking equipment. The stream bubbles out at a practical and convenient angle. Lips cannot touch jet—water cannot fall back. Drinking fountain experts proclaim this fountain as sanitary in every respect — overcoming every objection to the old bubbler type. Ideal for schools, public buildings, parks and streets.



Send address for illustrated descriptive matter treating on the subject of sanitary drinking fountains.

Our new 74 page drinking fountain Catalog "C" is ready for distribution.

Rundle-Spence Mfg. Co. Milwaukee Wisconsin

INDEX TO ADVERTISERS

After referring to the "Where to Purchase" Section, on pages 3 to 37, if you will look up the advertisements as per index below, you will be able to secure further data (with illustrations in many cases) on the material or equipment relative to which you are seeking information.

Does guess-work road building pay?

Common Sense Sez:

"NO!"

Road engineers who specify Bermudez Road Asphalt do not guess. They know. Years of service have proven it more durable and economical than any other bituminous road material known. They refuse to risk their own reputations and public money on cheap but untried imitations.

BERMUDEZ
Road Asphalt
"IT STAYS PUT"

holds the world's record for long life and low maintenance. Neither sun nor rain affect its nature-given tenacity and binding properties. These are *facts*—demonstrated by tests. Let us send you

"The Bermudez Road Book"

BERMUDEZ FACTS No. 2

Pernambuco, Brazil: Average Temperature 95 degrees F. 10,000 sq. meters of road built of Bermudez Road Asphalt (penetration method) 6 years ago.

NOT ONE CENT FOR MAINTENANCE

The Barber Asphalt Paving Company
PHILADELPHIA